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VETERINARY MATERIA MEDICA
AND THERAPEUTICS

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HOARE'S VETERINARY MATERIA MEDICA AND THERAPEUTICS

SIXTH EDITION

EDITED AND REVISED BY

J. RUSSELL GREIG, C.B.E.

PH.D.(EDIN.), M.R.C.V.S., F.R.S.E.

DIRECTOR, MOREDUN RESEARCH INSTITUTE, EDINBURGH; HON.
RESEARCH PROFESSOR IN ANIMAL PATHOLOGY IN THE ROYAL
(DICK) VETERINARY COLLEGE, EDINBURGH

AND

GEORGE F. BODDIE

B.Sc.(EDIN.), M.R.C.V.S.

PROFESSOR OF MEDICINE AND PHARMACOLOGY IN THE ROYAL (DICK),
VETERINARY COLLEGE



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PREFACE TO THE SIXTH EDITION

IN view of recent important advances in Veterinary Therapeutics the need for a new edition of 'Wallis Hoare's *Materia Medica*' has for some time become increasingly clamant, but because of the prevailing circumstances its production has been necessarily delayed.

In the preparation of the present edition I have been fortunate in obtaining the collaboration of my colleague Professor G. F. Boddie, and this, as can be readily understood, has not only lightened the task of preparation but has also very considerably enhanced the usefulness of the book.

The value of the barbiturates and of the sulphanilamides in Veterinary Practice has for some time been established, and apart from critically reviewing the entire text my collaborator has contributed the articles relating to these important substances.

The now generally accepted practice of calcium therapy in the specific treatment of milk fever and the allied conditions of acute hypocalcæmia has occasioned the rewriting of the articles relating to these matters, and in general the text has been brought into line with the accepted practice of Veterinary Therapeutics as that obtains to-day.

Appreciative thanks are due to Mr. R. H. Sherwood Calver, Advocate Depute for Scotland, Lecturer in Jurisprudence, Royal (Dick) Veterinary College, for having contributed the article on the Law relating to Dangerous Drugs and to Poisons. It is also proper to acknowledge the assistance afforded by my son, Mr. Alastair Greig, who, besides having generally reviewed much of the text, has also offered many acceptable suggestions. Miss Agnes McCracken and Miss B. H. Morgan also have readily rendered much useful help in several ways.

I am grateful to the publishers, Messrs. Baillière, Tindall and Cox, for having extended their usual friendly encouragement

and pleasant courtesy; but to them and to their printers, Messrs. Billing and Sons Ltd., I would also express my lively appreciation, indeed admiration, of the way they have surmounted conditions occasioned by enemy action which, not so long ago, would generally have been regarded as quite appalling.

J. R. G.

MOREDUN INSTITUTE,
EDINBURGH.
March, 1942.

PREFACE TO THE FIFTH EDITION

IN the present book the general plan of the work conforms to that followed in the last edition. An attempt has been made to present Part I. in more concise and lucid form, and in revising and largely rewriting the section on *Materia Medica* I trust that I have been duly mindful of the now more clearly recognized claims of Pharmacology as the link in the teaching curriculum between Physiology and Therapeutics.

The recent publication of a new edition of the British Pharmacopœia has occasioned numerous alterations in nomenclature and in formulæ. Many preparations now no longer official, which have proved of value in veterinary practice, have been retained in the text, the adoption of this expedient being necessary because of the continued absence of an official Veterinary Pharmacopœia.

The section on Therapeutics has been almost entirely rewritten. It aims at conciseness rather than at completeness, and if several of the views which I have expressed, especially where these relate to pathogenesis, savour of originality rather than of orthodoxy, and are thus open to criticism in a work of this kind, it can be claimed that they rest on accepted physiological bases.

The preparation of a new edition of a standard textbook on Veterinary *Materia Medica* and Therapeutics imposes no light responsibility upon one who is no longer actively engaged in the teaching of these subjects, and I am warmly appreciative of the ready assistance afforded by the many professional friends from whom I have sought guidance upon doubtful points. Mr. Arthur Gofton has revised and extended the section on the Biological Tests in Clinical Diagnosis, and has written the short article on the Care and Management of the Parturient Cow. To him I am also indebted for the critical revision of Parts I. and III. I have also specially to acknowledge the services of my colleagues. Professor Henry Dryerre has revised much of the text and collaborated freely on those aspects relating to Physiological Biochemistry. Mr. Alexander Brownlee has checked all the formulæ and posology, and has offered many helpful suggestions. Mr. W. S. Gordon has assisted in the preparation of the section on Vaccine and Serum Therapy. Mr. Norman Walker, Advocate, Lecturer on Jurisprudence, Royal (Dick) Veterinary College, has

contributed the article on the Law relating to Dangerous Drugs. To my secretary, Miss Agnes Marcus, I am particularly indebted for her devoted personal service throughout the entire work of preparation, and for her careful compilation of the Index.

I have also to acknowledge the kindness of Professor Walter Dilling, and of his publishers, Messrs. Cassell and Company, in permitting the free use of those portions of the text of Bruce and Dilling's 'Materia Medica and Therapeutics' which concern the source, the physical characters and the composition of drugs; and I am personally grateful to Mr. Rudyard Kipling for special permission to quote certain verses of 'Our Fathers of Old.' I believe that these few ringing lines will more deeply impress their lesson upon the mind of the student than would many pages of prosaic text. Finally, I have to express my appreciation of the unfailing courtesy and helpfulness of the publishers.

While acknowledging the assistance of these several collaborators, I feel that to offer them my personal thanks is needless, since their various contributions to the preparation of the text, in common with my own, have been rendered in the hope that this book may prove of some service to the advancement of Veterinary Science.

J. R. G.

MOREDUN INSTITUTE,
EDINBURGH.
May, 1933

CONTENTS

PART I

	PAGES
INTRODUCTION—DIAGNOSIS AND THE GENERAL SYMPTOMS OF DISEASE—THE CARE, MANAGEMENT, AND NURSING OF SICK ANIMALS—THE ACTIONS AND USES OF DRUGS—PRESCRIBING AND PRESCRIPTION WRITING—THE ADMINISTRATION OF MEDI- CINES—VETERINARY PHARMACY - - -	1-105

PART II

MATERIA MEDICA - - - - -	106-363
VACCINE AND SERUM THERAPY - - - - -	363-374
BIOLOGICAL TESTS - - - - -	375-383

PART III

THERAPEUTICS - - - - -	384
THE DIGESTIVE SYSTEM - - - - -	384
THE LIVER - - - - -	416
THE PERITONEUM - - - - -	418
THE URINARY ORGANS - - - - -	420
THE RESPIRATORY ORGANS - - - - -	427
THE CIRCULATORY ORGANS - - - - -	443
THE NERVOUS SYSTEM - - - - -	448
CERTAIN SPECIFIC DISEASES - - - - -	451
MINOR OPERATIVE PROCEDURES - - - - -	469
APPENDIX I. FORMULÆ - - - - -	480
APPENDIX II. THERMOMETRIC EQUIVALENTS - - - - -	507
APPENDIX III. DANGEROUS DRUGS ACTS AND POISONS ACT - - - - -	508
INDEX - - - - -	517

'We must first of all put it on record that without the aid of Nature neither precept nor practice will be of much service to us.'—QUINTILIAN: *De Institutione Oratoria*, Proœmium, 26.

'A judicious distrust and wise scepticism are the sinews of the understanding.'—EPICHRMUS.

'Art is born of the observation and investigation of Nature.'—CICERO: *Orat.* v. 183.

'It cannot be denied that we have learned more rapidly how to prevent than how to cure diseases; but, with a definite outline of our ignorance, we no longer live now in a fool's paradise, and fondly imagine that in all cases we control the issues of life and death with our pills and potions.'—OSLER.

OUR FATHERS OF OLD

Excellent herbs had our fathers of old—
Excellent herbs to ease their pain—
Alexanders and Marigold,
Eyebright, Orris, and Elecampane—
Basil, Rocket, Valerian, Rue,
(Almost singing themselves they run,)
Vervain, Dittany, Call-me-to-you—
Cowslip, Melilot, Rose of the Sun.
Anything green that grew out of the mould
Was an excellent herb to our fathers of old.

Wonderful tales had our fathers of old,
Wonderful tales of the herbs and the stars—
The Sun was Lord of the Marigold,
Basil and Rocket belonged to Mars.
Pat as a sum in division it goes—
(Every herb had a planet bespoke)—
Who but Venus should govern the Rose?
Who but Jupiter own the Oak?
Simply and gravely the facts are told
In the wonderful books of our fathers of old.

Wonderful little, when all is said,
Wonderful little our fathers knew.
Half their remedies cured you dead—
Most of their teaching was quite untrue—
Look at the stars when a patient is ill.
(Dirt has nothing to do with disease,)
Bleed and blister as much as you will,
Blister and bleed him as oft as you please.
Whence enormous and manifold
Errors were made by our fathers of old.

* * * * *
If it be certain, as Galen says—
And sage Hippocrates holds as much—
'That those afflicted by doubts and dismays
Are mightily helped by a dead man's touch,'
Then, be good to us, stars above!
Then, be good to us, herbs below!
We are afflicted by what we can prove,
We are distracted by what we know,
So—ah, so!
Down from your heaven or up from your mould,
Send us the hearts of our fathers of old!

RUDYARD KIPLING.

VETERINARY MATERIA MEDICA AND THERAPEUTICS

PART I

INTRODUCTION

VETERINARY Therapeutics is the subject which concerns the treatment of disease in the domesticated animals. In its wide sense it embraces not only the application of medicinal agents, vaccines, and sera, for this purpose, but it also includes such important auxiliaries as hygiene, dietetics, and the care, management, and nursing of sick animals.

Pharmacology deals with the action of drugs on the body, without special reference to their application in the treatment of disease. In this book the subject of pharmacology will be discussed only in so far as it relates to therapeutics ('Applied Pharmacology'). For further information readers are referred to general textbooks on Pharmacology.

Materia Medica deals with the name, source, distribution, composition, physical characters, and preparations of the various agents employed by the therapist.

Pharmacy is the art of compounding and dispensing formulæ or prescriptions.

The ability of the general practitioner is largely dependent on his skill in diagnosis, prognosis, and treatment. His professional education is largely directed to rendering him proficient in these matters. Clinical proficiency entails an intimate knowledge of pathology, but a knowledge of pathology alone will not suffice; the clinical symptoms of disease must be studied and interpreted. This requires a sound knowledge of physiology, which is in fact the basis of rational therapeutics, for unless we be acquainted with the functions of healthy organs we cannot have any clear perception of the alterations in function produced by disease, or of the manner in which medicinal agents assist in bringing about a return to health. It is not always possible to form a precise diagnosis; the leading symptoms must therefore receive consideration, as they offer important indications for treatment. There are many

occasions, also, on which a diagnosis alone cannot be regarded as representing sufficient indication for a particular treatment, and the special features of the case must be studied. If every disease possessed a set of regular symptoms, and yielded to a definite form of treatment, then indeed therapeutics would be much simplified. But the symptoms presented are frequently atypical; diagnosis is often attended with considerable difficulty, and a line of treatment that succeeds in one case may fail in other cases of the same disease. Further, our knowledge of the action of drugs on diseased organs is far from definite, and it is often a very difficult matter to determine the exact influence which a certain drug or a particular treatment exerts on a diseased condition.

One of the first lessons which the student of veterinary medicine must learn is that natural powers of recovery exist to a greater or less extent in the majority of diseased conditions. A marked influence on the course and results of disease is exerted by *vis medicatrix naturæ*, and in assessing the value of medicinal agents it is necessary that the student realize that recovery is not always to be attributed to the effects of the drugs administered. He must also appreciate the fact that, in adopting any line of medicinal treatment, care should be taken to select agents which assist the natural powers of recovery, and to avoid those likely to be antagonistic to these powers. The irrational treatment adopted in former times must be attributed to lack of appreciation of these powers of recovery, to a firm belief in the virtues of certain potent drugs, and to the erroneous idea that in all cases there existed the means by which the effects of disease could be directly overcome. Although new medicinal agents are constantly being introduced, drugs are now less frequently prescribed than formerly. In these days we endeavour to assist the natural powers of recovery by attention to hygienic and dietetic details, and to the careful nursing of the patient. As has been indicated, animals may recover spontaneously from many affections, and the indiscriminate administration of drugs frequently tends to impede recovery.

The term '*rational therapeutics*' is used with reference to the application of remedial measures when we can clearly explain the reasons for their adoption. This implies a precise diagnosis, a knowledge of the etiology of the affection, so that we can act directly or indirectly on the causes which produce it, and an intimate knowledge of the actions of the drugs which we employ. All these desiderata are usually very difficult to fulfil.

In '*empirical therapeutics*' certain agents prove successful in a series of cases of the same disease, although it is not possible

to explain their action. Their value has been demonstrated by experience.

So-called 'specific' remedies are not numerous, and in several instances their mode of action has not yet been determined.

It is to be observed that in the case of horses and of 'food animals' treatment is limited by economic considerations. If a horse cannot be rendered useful for work, the owner seldom desires that its life should be prolonged. In cattle a long course of treatment is seldom desirable, as loss of physical condition results, and, unless there be a reasonable prospect of recovery, it is advisable to dispose of the animal to the abattoir in the early stages of the case, provided that there exist no diseased condition such as would render the flesh unfit for human consumption.

In the dog, considerations of sentiment largely enter into the question of treatment, and, provided humanitarian considerations permit, a prolonged course of treatment may be undertaken.

In each of the domestic animals there occur certain specific diseases which are communicable to man; in such instances destruction, and not treatment, of the affected animals may have to be adopted. In certain highly infectious epizootic diseases, immediate destruction of the affected animals and their contacts proves the most economic policy. This procedure is indicated in dealing with foot and mouth disease, which, although amenable to treatment, spreads with such rapidity and interferes to such an extent with the cattle trade of a country, that, on grounds of economy, treatment is not desirable.

DIAGNOSIS AND THE GENERAL SYMPTOMS OF DISEASE

IN order to prescribe rational treatment for the sick animal, it is necessary to ascertain the nature of the illness from which the patient is suffering. The diagnosis is based on the history of the case, on the proper interpretation of the symptoms presented, and on knowledge of the probable causes which have produced the disease. Having formed a diagnosis, we have then to consider the selection of the line of treatment which is likely to assist the natural powers of recovery and so bring about a return to health. In some cases we are able to act directly on the cause, and so to remove it. In others we have to treat the leading symptoms present, as, because of absence of evidence indicating the precise nature of the disease, a definite diagnosis is impossible at our earlier examinations of the patient.

The general symptoms merit consideration, and afford valuable indications for treatment. Thus, alterations in the character of the pulse and respirations, the presence of fever, the condition of the excretions, etc., must be carefully observed and regarded as clinical guides, even when a precise diagnosis has been attained.

Symptomatic treatment—*i.e.*, the treatment of symptoms without reference to their source or causation—is irrational except when the conditions upon which the symptoms immediately depend are the cause of pain or acute discomfort to the patient. For example, acute abdominal pain in the horse frequently depends upon impaction of the large bowel. The pain may be controlled by the use of opiates, and this formerly constituted the accepted treatment for the condition. But it was obviously irrational, since the pain depended upon intestinal impaction, and opiates, while capable of relieving the pain, induced bowel stasis. Rational treatment consists in stimulating intestinal peristalsis with the object of removing the *cause* of the pain, and the pain in turn can be controlled by anodynes, such as chloral hydrate, which do not hinder the action of the purgative.

Examples of a similar kind are of frequent occurrence in practice. Thus, nervous phenomena may be associated with

gastric disorders, and cardiac disturbance may result from digestive derangement. Treatment in such cases should not be directed alone to the alleviation of the symptoms without reference to their origin.

Our patients, unlike human beings, are unable either to describe the sensations they experience (subjective symptoms), or to give any direct assistance to the medical attendant. We have, therefore, largely to depend upon those symptoms which can be observed (objective symptoms). A well-trained faculty of observation, and familiarity with the appearance and habits of animals in health, are among the most valuable attributes of the veterinary student.

It is not uncommon to find that at the first examination of a case a definite diagnosis is not possible, as the symptoms presented may be indefinite or general—*i.e.*, common to a number of affections. Until more definite symptoms appear, an opinion upon the nature of the case must be deferred.

Prognosis, or foretelling the probable termination of the case, is of special importance, because, as has been indicated, veterinary therapeutics is, especially in the case of horses and cattle, limited by considerations of economy. The cost of prolonged treatment has, therefore, to be considered in relation to the probable value of the animal after recovery.

The History of the Case—ANAMNESIS.—This is a very important aid to diagnosis. We have to rely on the attendant in charge of the animal for the requisite information. Because of the imperfect power of observation possessed by some individuals, it is often difficult to obtain a reliable history. Further, because of carelessness or ignorance, the attendant may be a contributory factor to the illness from which the patient is suffering, in which case his statements may be unreliable. It is often necessary to subject the attendant to a series of indirect questions in order to bring out facts. We inquire with reference to the length of time the animal has been in the present owner's possession, the duration of the illness, and whether the patient has previously suffered from disease. We next endeavour to obtain a description of the earliest symptoms that were noticed, and inquire whether other animals are showing similar signs of illness. Frequently the only information we can glean is that the animal refused to feed, appeared dull, and was disinclined for work. In the case of acute abdominal affections, we learn the time at which painful symptoms were first observed and their character—*i.e.*, whether they were intermittent or continuous. We may also ascertain whether rigors have been manifested; whether the bowels are acting

properly, and whether the urine is diminished or excessive in volume. In the case of female animals, we may inquire with reference to the occurrence of œstrum, to the existence of pregnancy, and to the occurrence of previous pregnancies. It is also necessary to ascertain whether any treatment has been adopted, as it is the layman's common practice to administer a powerful purgative upon the first appearance of illness. Such treatment is frequently entirely contra-indicated, and when draughts have been carelessly administered, the entrance of fluids into the bronchi may result in broncho-pneumonia. This is a common experience, and it is necessary to make a careful inquiry as to the occurrence of coughing and distress succeeding the administration of the medicine. The attendant may, however, deny any knowledge of the occurrence, and we have to rely on the evidence obtained from an examination of the chest and on the observation of other symptoms suggestive of 'inhalation pneumonia.'

In diseases of the digestive system, inquiries should be made with reference to the quality of the food and the method of feeding and watering adopted, also, in the case of horses, to the hours of working and the nature of the work.

Experience of the unreliable information we receive in so many instances teaches us that we must fully exercise our powers of observation, as by observing minor details we often ascertain matters of importance. Indirect questioning not infrequently succeeds when direct interrogation fails.

Primary Examination of the Patient.—Since our animals are unable to furnish us with subjective symptoms such as can be afforded by the human patient, our primary examination must largely be based upon such powers of acute observation as we possess and should include the most minute detail. The patient should be approached quietly and first examined at some little distance. Attention is paid to the general appearance, the facial expression, the postures and movements.

This examination should not be made hurriedly, as a considerable time may be required to comprehend the general state of the animal.

The Temperature.

The temperature is registered by inserting a clinical thermometer in the rectum. Care should be taken that the bulb of the thermometer comes into intimate contact with the mucous membrane of the bowel, and that it be retained in position for the requisite time, usually one-half minute. The

average normal temperatures of the domestic animals are as follows:

Horse	100.4° F.
Ox	101.5° F.
Sheep	103° to 105° F.
Pig	102.6° F.
Dog and cat	101.5° F.

These figures vary to a slight degree under certain circumstances; they are raised by muscular exertion and during periods of very warm weather.

An elevation of body temperature is known as pyrexia or fever, and is a symptom which occurs in a variety of disease conditions. A high temperature should not always be regarded as serious, but when suddenly occurring in a case that was progressing favourably, it may indicate a complication or a relapse. In that condition in the horse known as 'febricula,' or simple fever, a rise of temperature with loss of appetite and dulness represent the leading symptoms, but there is no evidence of involvement of any particular organ; the temperature returns to normal, and the patient becomes convalescent within a few days. Such cases are of common occurrence during epizootics of influenza, and while their nature has not been determined they may represent abortive attacks of that disease.

In recent years the older conception of the nature of fever has been considerably modified, and we now recognize that in infective fevers a rise in body temperature is indicative of the defensive response of the tissues to the invading infective agent; it therefore follows that the rise in temperature, being merely a symptom, should not be unduly combated unless it be so acute that the patient is seriously distressed, when it may be controlled by suitable antipyretics.

The use of the clinical thermometer is, however, a valuable guide to the conduct of the case, and the daily morning recording of the temperatures of horses in studs in which cases of infective fever are occurring enables us to recognize the necessity for ordering cessation of work even before clinical symptoms are manifested.

In surgical conditions, an elevation of temperature may be an important danger-signal.

A markedly subnormal temperature should generally be regarded as a very grave symptom.

Alterations in the Character of the Pulse and of the Action of the Heart.

In every case of disease a careful examination of the pulse and of the action of the heart should be made. In all affections, alterations in the character of the pulse furnish valuable indications to the therapist, and must be regarded as among the most important of the general symptoms of disease.

The pulse is the wave set in motion by the propulsion of blood by the heart into the arteries. Under normal conditions each beat of the pulse corresponds to a contraction of the heart. We can therefore appreciate the gravity of a weak, failing, or thready pulse.

The characters of the normal pulse should be carefully studied. In the horse the submaxillary artery offers the most convenient location for examining the pulse; but in cases in which the action of the heart is weak, the posterior radial artery at the internal aspect of the forearm is preferable. Under normal conditions the beats are regular, and number thirty-five to forty per minute. The artery under gentle pressure offers a certain degree of firmness which is readily appreciated by trained fingers.

In cattle, the normal pulse numbers about fifty per minute, and may be taken at the submaxillary, the posterior radial, and the coccygeal arteries. The number of beats cannot be regarded as a reliable guide in cattle, because the approach of a stranger is sufficient to induce an increase in the number of pulsations, and a similar effect is observed during rumination or after the ingestion of warm food.

The pulse of the dog varies, according to the size and breed of the animal, from eighty to one hundred per minute. It is most conveniently taken at the femoral artery on the inner aspect of the thigh, and in judging its character it is essential that the animal should be quietly handled and that excitement should be avoided. An intermittent pulse is a normal condition in the dog.

In assessing the significance of alterations in the character of the pulse, it is necessary to ascertain the primary condition upon which these alterations depend. Digestive derangements, nervous disorders, and anæmia, are some of the several conditions which may give rise to irregularity of the pulse-beat (see p. 445).

The following varieties of pulse are met with:

THE FREQUENT PULSE.—In this condition the number of beats per minute is increased. In nervous animals a frequent pulse may be coexistent with perfect health. Repletion of the digestive organs, exertion, or excitement, cause a temporary

increased frequency of the pulse. In the primary stages of fevers and in inflammation of visceral organs a frequent pulse is encountered.

THE INFREQUENT PULSE is often associated with the character of slowness, and is met with in certain cerebral disorders.

THE QUICK PULSE.—In this variety each beat occupies less than the usual time, although the number of pulsations per minute may not be increased. It depends on the mode of contraction of the ventricles, and is met with in cases characterized by excessive nervous irritability, and in some forms of cardiac disease.

THE SLOW PULSE indicates a prolonged or slow contraction of the ventricles. It occurs in cases of aortic stenosis, and in jaundice.

THE LARGE PULSE is characterized by a fulness in volume, and may occur in association with either strength or feebleness of the pulsation.

In severe congestion of the lungs the artery is full in volume, but the pulsations are weak. This has been termed the 'oppressed pulse.'

THE SMALL PULSE.—In this type the volume is smaller than normal, and is associated with enfeebled cardiac action.

THE HARD PULSE.—Contraction of the muscular coat of the arterial walls causes this condition of pulse. The artery is incompressible to the touch, and when associated with the character of smallness the pulse is termed 'wiry' or 'thready.' In inflammation of serous membranes, such as pleurisy, pericarditis, peritonitis, and meningitis, the pulse in the primary stages is small and hard. The hard pulse may be associated with the character of largeness, as in cases of acute laminitis, in which the pulse may be described as quick, full, and bounding.

THE SOFT PULSE may be associated with the condition of slowness, and as such it occurs towards the termination of chronic exhausting diseases; the impulse of the heart is weak, and the volume of blood propelled at each ventricular systole is deficient.

STRENGTH AND WEAKNESS OF PULSE.—Distinction must be made between a *strong* pulse and a *full but feeble* pulse. The latter is generally associated with slow action of the heart and relaxation of the arterial coats.

INTERMITTENT PULSE.—In this a pulsation is periodically omitted. The intermission may occur at regular intervals—*i.e.*, at the end of a certain number of beats, or irregularly, so that only an occasional omission of a beat is observed; this is termed an 'irregularly intermittent pulse.'

In certain cardiac affections the ventricular systole is too

feeble to develop a perceptible pulse-beat—*i.e.*, the pulse-wave is abortive—hence the pulse is found slow and intermittent, although the cardiac contractions are normal as regards frequency; this is sometimes referred to as ‘false intermission.’ An intermittent pulse may be compatible with apparent health in the horse, and, as already remarked, is a normal condition in the dog.

IRREGULAR PULSE.—The pulsations are irregular in time and are usually unequal in force. It may be a temporary condition arising from slight reflex irritation, such as occurs in indigestion, or from one of the several causes of gastro-intestinal irritation. When persistent, it is often associated with cardiac diseases.

‘**WATER-HAMMER,**’ COLLAPSING, OR CORRIGAN’S PULSE is met with in aortic insufficiency and in aneurism of the aorta. The pulse-beat is sudden and abrupt, and is followed by an equally sudden collapse of the artery.

JUGULAR PULSE OR ‘VENOUS PULSE.’—In the normal horse distinct pulsations are seen in the jugular veins at the base of the neck, but they do not extend any distance upwards, and are believed to depend on the pulsations in the carotid arteries. The normal jugular pulse is due to a backward positive wave in the anterior vena cava which occurs at the moment of systole of the auricles. When horses are cast for operations a more distinct jugular pulse is observed, and Stockman suggested that it probably originates in a congestion of the pulmonary vessels. In the case of the *true* venous pulse a well-marked wave passes up each jugular vein with each cardiac systole, and is followed by a retrograde wave. This is plainly visible to inspection, and the wave is double. Although a jugular pulse is said to be pathognomonic of insufficiency of the tricuspid valve, it is also observed in cases of incompetency of the mitral valve and in pericarditis with effusion. In many instances a distinct dilatation of the jugular veins is associated with a jugular pulse.

The varieties of pulse mentioned often offer important indications in all forms of disease. In gastric and intestinal affections the character of the pulse is an important guide to diagnosis and prognosis. Its frequency and its general character should be specially noted, not only in the early stages, but also during the later course of the affection. In the so-called ‘spasmodic colic,’ the pulse becomes frequent during the paroxysms of pain; but in the intervals of ease it returns to normal. In acute intestinal affections it is greatly increased in frequency, and also becomes irregular, fluttering, and weak; while in cases approaching a fatal termination it becomes indistinct, thready, and finally imperceptible.

The occurrence of irregularity or intermittence of the pulse may in itself be of little importance, as these conditions may arise from functional aberrations of a transient nature. On the other hand, they may be dependent upon organic cardiac disease, and their relative importance can only be determined by an examination of the heart itself.

PHYSICAL EXAMINATION OF THE HEART.

INSPECTION.—In 'well-conditioned' horses that are clipped, the cardiac impulse may be visible when the heart has been unduly exerted or is palpitating.

Inspection also enables us to detect the presence of a jugular pulse.

PALPATION—*i.e.*, the application of the palm of the hand over the region of the heart—is employed to determine the character of the cardiac impulse, and to detect the presence of a fremitus or 'thrill.'

The Cardiac Impulse is felt between the fifth and sixth ribs a few inches above the sternum. It is not produced by pulsation of the apex, but by the lower half of the left ventricle. In plethoric horses the cardiac impulse is not felt with facility.

Fremitus or Thrill.—This is detected in some cases of valvular disease, and is believed to be due to the vibration of the valve cusps being transmitted to the blood. In some instances it is of a purring character (*frémissement cataire*).

PERCUSSION.—This procedure consists in striking lightly with the tips of the fingers upon the surface of the cardiac region. It is applied in order to determine the presence of an increase in the area of cardiac dullness, such as occurs in cardiac hypertrophy, and also in pericardial effusion and hydropericardium. Stockman found that if absolute dullness be detected in the area extending from the posterior border of the fifth rib into the sixth intercostal space, one may conclude that hypertrophy of the heart is present. He found that cardiac dullness never extended beyond the seventh rib.

AUSCULTATION.—Auscultation of the heart, the act of listening to the cardiac sounds, may be performed 'directly'—that is, by placing the ear over the cardiac region—or 'indirectly' by means of the stethoscope. The binaural stethoscope is the most useful type in veterinary practice. A rubber cap fitted over the end of the receiver will be found of great advantage in that it obviates friction sounds. Perfect quietness of the surroundings is essential. It must be recognized that, in nervous or unhandled horses, the mere application of the instrument may cause disturbance of the

cardiac action, and this may be mistaken for evidence of disease. Because of anatomical peculiarities in the larger animals, auscultation of the heart is attended by marked difficulties. These peculiarities are: the heavy muscular shoulder which covers the upper and anterior region of the heart, the thickness of the thoracic walls, and the small area of the organ which is available for examination because of the heart being to a great extent covered by the lungs. It is difficult or impossible to examine the large vessels arising from the heart.

Nevertheless, some at least of these difficulties can be overcome, and, as Stockman pointed out, by drawing the left fore-leg of the animal well forward, so as to expose the third rib, a considerable portion of the cardiac area can be made available for auscultation. This observer found that the cardiac sounds are heard to greatest advantage in the areas which correspond most closely to the seat of their production. Thus the first sound is best heard at the anterior border of the fifth rib in the cardiac area, being carried well backwards and downwards over the extent of the ventricular wall. The sound diminishes in intensity in a forward direction until it almost disappears at the posterior border of the third rib. The second sound is best heard at the anterior border of the fourth rib in the cardiac area; it decreases in distinctness in a backward direction, and is carried well down the ventricular wall.

With reference to reduplications of the sounds, Stockman observed that such a condition may be compatible with health, and that the first sound is frequently double in the absence of any cardiac lesion.

MURMURS.—These are abnormal sounds which may precede, supplant, or follow one or other of the cardiac sounds. They usually depend on the presence of lesions in the cardiac valves, but may also occur in the absence of valvular lesions—*e.g.*, in anæmia, and in marked cardiac dilatation.

Authorities differ in their views as regards the means by which murmurs are produced. It is believed that in valvular incompetency the column of blood passes in a backward direction and meets with the advancing one; so an eddy is produced and a murmur arises. In stenosis of a cardiac orifice the volume of blood passes through it with difficulty into a relatively large cavity beyond, and a murmur results.

With regard to the time at which murmurs are heard, they are termed *systolic* when related in time to systole, and *diastolic* when related in time to diastole. When occurring just previous to systole—*i.e.*, with the auricular contraction—they are termed *presystolic*.

In order to determine the time of the murmur, a finger is placed on a convenient artery, and if the murmur be found coincident with the pulse, it is systolic in time; if, on the other hand, it be heard after the pulse or after the second sound of the heart, it is diastolic in time.

It is frequently a matter of extreme difficulty to distinguish functional cardiac affections from organic cardiac diseases. Such distinction is made only by a careful physical examination of the heart, and by attention to the general phenomena exhibited. Treatment must be adopted according to the conditions on which the symptoms depend.

Symptoms associated with the Respiratory Functions.

In the horse, under normal conditions, the ratio of the respirations to the pulse is usually one respiratory movement to three or four pulsations. In cattle this relation is not constant; for example, during rumination the pulse may rise to seventy or eighty per minute, while the respirations may number ten. In stall-fed cattle, especially during hot weather and after feeding, the respirations may be so accelerated as to suggest the presence of an acute respiratory disease.

Accelerated Respirations and Dyspnoea.—Accelerated respirations are not always indicative of respiratory affections. They are concomitant with fever and are also observed in acute painful inflammatory conditions, such as laminitis, enteritis, and septic arthritis. Dyspnoea occurring in respiratory affections may depend on various conditions:

1. Obstruction to the entrance of air to the lungs, such as occurs in cedema glottidis.
2. Lessened area for respiration in the lung itself, as in pneumonia.
3. Interference with the expansion of the lungs, caused by a pleural effusion in the cavity of the chest.
4. Pleurisy, in which the respiratory act is painful, and the respirations quick and shallow.
5. Engorgement of the lungs with venous blood, such as occurs in acute pulmonary congestion.
6. Pulmonary emphysema ('broken wind'), in which the alveoli lose their elasticity, or a proportion of them become confluent, so that expiration is performed with difficulty.

Abnormal Types of Respiration—I. ABDOMINAL BREATHING.—In abdominal breathing the movements of the thoracic walls are reduced to a minimum. The ribs are to a certain extent fixed, and a hollow line is observed extending along the lower borders

of the false ribs from the sternum to the anterior spine of the ilium; this is termed the 'pleuritic ridge.' The abdominal muscles then act as auxiliaries, and compensate for the limited action of the special muscles of respiration. The respirations are quick and incomplete. This type of breathing is observed in acute febrile affections in horses and cattle, in which animals, because of the abdominal contractions, the character of the respirations is described as 'lifting.' It is seen in its most acute form in pleurisy.

2. **THORACIC BREATHING.**—This is characterized by the abdominal muscles being as far as possible held in a state of quiescence, with increased compensatory movements of the thoracic walls. It is observed in peritonitis, ascites, and intestinal tympany.

3. **IRREGULAR BREATHING.**—In this type the inspiratory movement is performed rapidly, while expiration is accompanied by two contractions of the abdominal muscles. The first abdominal contraction is abrupt and is quickly followed by the second, which is prolonged. This type of breathing is observed in 'broken wind.'

4. A snoring or roaring sound, accompanying especially inspiration, is met with in acute laryngitis.

Cough.—A cough may be a symptom of a respiratory affection, in which case it usually depends on some irritation of the larynx, or bronchial tubes; or it may have its origin in some peripheral irritation such as may arise from indigestion, or the presence of internal parasites.

THE DRY COUGH occurs during the first stages of catarrhal affections. In pleurisy the cough is also dry, and is short, suppressed, and painful.

THE MOIST COUGH is met with in the secondary stages of catarrhal affections, and indicates the presence of an increased secretion of mucus.

THE CHRONIC COUGH varies in type. In 'broken wind' it is short, shallow, dry, suppressed, and usually single. It may, however, occur in paroxysms. In 'roaring' the cough is deep and hollow.

THE PAROXYSMAL COUGH is observed in acute laryngitis, and in the secondary stages of bronchitis.

Nasal Discharge.—This varies in character and volume. It may consist of mucus or pus, or may be muco-purulent in character. In some cases of pneumonia in the horse it is rusty-coloured. Though a nasal discharge is a usual accompaniment of those respiratory catarrhs so commonly met with in practice, its occurrence in a chronic form is symptomatic of one or other of the following diseased conditions:

1. CHRONIC CATARRH OF THE MUCOUS MEMBRANE OF THE NASAL CAVITIES.—Discharge usually bilateral, yellow or yellowish-white, and fairly thick. No striking difference in the volume of discharge in relation to the position of the head, but it is usually more profuse in the morning. Non-fœtid. Sometimes accompanied by a cough and considerable snorting. Slight bilateral enlargement of submaxillary lymphatic glands.

2. CHRONIC CATARRH OF THE MUCOUS MEMBRANE OF THE AIR-CAVITIES.—Discharge generally unilateral, yellow, and often clotted. Frequently comes in quantity when head is held low. Usually fœtid. Snorting and cough usually absent. Enlargement of submaxillary gland on the affected side. Exploratory puncture will reveal the source of the trouble. Percussion over the facial sinuses may reveal dullness, and in very severe or advanced cases there may be softening and bulging of the maxillary bone.

3. NEOPLASM FORMATION IN THE AIR-CAVITIES.—Symptoms usually similar to those of the previous condition, but on trephining the affected sinus it will be found more or less blocked by the tumour and profuse hæmorrhage may occur.

4. DISCHARGE DUE TO DISEASED MOLAR TEETH.—As the alveoli of the majority of the upper molars extend into the air-sinuses, disease of the roots of these teeth induces a purulent condition of the sinuses before any nasal discharge is shown. The symptoms in many cases are indistinguishable from those arising from a chronic catarrh of the sinuses, and the only diagnostic evidence is that furnished by the diseased tooth itself. Sometimes difficulty and pain in mastication are observed. In some cases particles of food obtain entrance into the sinuses, and may appear in the nasal discharge. The discharge is usually fœtid. The lymphatic glands of the affected side are enlarged.

5. DISCHARGES ARISING FROM TUMOUR FORMATION IN THE POSTERIOR NARES.—The presence of a tumour usually excites an abnormal amount of secretion, the discharge of which it may partially obstruct. The discharge is unilateral, usually yellowish in colour, mucoid, or purulent, and possibly fœtid. There is considerable snorting, and the air-passage is more or less diminished, and occasionally entirely obstructed. There is usually enlargement of the submaxillary gland on the affected side.

6. DISEASE OF THE TURBINATED BONES.—The discharge is purulent and fœtid. It may escape more profusely if the head be elevated and then lowered. Very occasionally there is some obstruction to the passage of air. The discharge is usually unilateral, and the submaxillary gland on the affected side is enlarged.

7. **DISEASE OF THE GUTTURAL POUCHES.**—The discharge is generally unilateral, purulent, and may be foetid. It is intermittent, and usually much increased when the head is depressed. There is generally swelling in the parotid region, and gentle pressure upon it increases the flow of the discharge. There may be a cough, and sometimes there is interference with respiration.

8. **ABSCESS IN THE LUNGS.**—An open abscess in the lung may be an unsuspected cause of a nasal discharge. In this case the discharge will be bilateral (although frequently more marked on one side), purulent, and foetid. It varies very much in quantity, and it is noticed that the breath is foetid even when no discharge is present. Cough is usually evident and may be violent in character. Enlargement of the submaxillary lymphatic glands is usually absent. Constitutional symptoms may or may not be present.

9. **GLANDERS.**—In glanders the nasal discharge is generally scanty and glue-like in appearance, and tends to adhere to the nostrils; it is accompanied by swelling and induration of the submaxillary gland. Unless ulcers characteristic of glanders can be detected, the diagnosis must be based on the result of the mallein test.

In all cases of chronic nasal discharge, unless the cause be evident, it is advisable to carry out the mallein test (p. 381).

Physical Examination of the Chest.—In order to attain proficiency in the physical examination of the chest in disease, the student must first be familiar with the character of the normal respiratory sounds.

In considering the signs elicited by a physical examination of the normal chest, it is convenient to map out each side of the chest into three areas—viz., upper third, middle third, and lower third.

Normal Physical Signs obtained by Percussion in the Horse.—Percussion is carried out either with the tips of the fingers or by means of a hammer-like instrument termed a 'plexor' and a flat plate or 'pleximeter' placed between the plexor and the surface to be percussed. Percussion sounds are most pronounced over those parts least covered by soft tissues.

LEFT SIDE—Upper Third.—From behind the shoulder to the twelfth or thirteenth rib the sound is resonant; posterior to this it becomes gradually dulled.

Middle Third.—From the sixth to the twelfth rib resonance is most marked; it diminishes to the fifteenth rib.

Lower Third.—In the area over the fifth, sixth, and seventh ribs the sound is higher pitched and dull, due to the space being occupied by the heart. From the seventh to the thirteenth rib a slight resonance may be detected.

RIGHT SIDE—Upper Third.—Percussion sound similar to that obtained on the left side. Posterior to thirteenth rib, forcible percussion elicits increased resonance owing to the proximity of the double colon.

Middle Third.—Resonance similar to left side; posterior to fifteenth rib it becomes dull, owing to proximity of the liver.

Lower Third.—Resonance similar to left side; posterior to seventh rib it is dull, because of the proximity of the liver.

Normal Physical Signs obtained by Auscultation.—By auscultation of the chest is meant the act of listening to the respiratory sounds. By this means abnormalities in the respiratory sounds or the presence of adventitious sounds may be detected. Auscultation may be performed by applying the ear to the side of the chest (direct method), or by using a stethoscope (indirect method).

Vesicular murmurs and bronchial sounds should be recognized and studied in the normal chest.

VESICULAR OR RESPIRATORY MURMUR.—This is heard to best advantage over the middle third of the chest, just behind the shoulder. It is soft in character, and is caused by the air entering and leaving the alveoli. The expiratory sound is weaker and shorter than the inspiratory. The vesicular murmur can only be detected with difficulty, and may be impossible to recognize in plethoric animals. In many perfectly healthy chests the expiratory murmur can scarcely be heard, and in some instances both inspiratory and expiratory murmurs may be obscure or even undetectable.

TUBAL OR BRONCHIAL SOUNDS.—These are blowing and harsh in character; they begin and end abruptly, are of about the same duration in inspiration and expiration, and are separated by a short pause. They depend on the air passing through the larger bronchi, and are detected by auscultating the breast over the lower end of the trachea, or the upper third of the chest immediately behind the shoulder.

The following points should be noted in the auscultation of the chest:

LEFT SIDE—Upper Third.—Respiratory sounds loud and somewhat harsh, being chiefly bronchial.

Middle Third.—Vesicular murmur detected from fourth to sixth rib, more distinct to the ninth rib, and gradually diminishing to the sixteenth rib.

Lower Third.—Respiratory sounds replaced by cardiac sounds over the fourth to the sixth ribs. Vesicular sounds heard over the seventh and eighth ribs, and absent over the tenth rib.

RIGHT SIDE—Upper and Middle Third.—Similar to those on the left side.

Lower Third.—Vesicular sounds heard over fourth to seventh ribs, and diminish to tenth rib.

Abdominal Sounds.—These are of a gurgling character, and have no relation to the rythmical respiratory action. They may be heard over the middle and lower third, and especially over the posterior part of the chest.

Having become familiar with the normal physical signs, the student should next devote attention to abnormal respiratory sounds. These must be studied clinically in cases of disease. The following are the chief points to be noted:

Abnormal Percussion Sounds—**INCREASED RESONANCE.**—This may be general or partial. It is general in extensive pulmonary emphysema and in pneumothorax.

Partial increase of sound is observed when portions of the lung become hepatized in pneumonia, or compressed by false membranes or by pleural effusion in pleurisy. The unaffected portions then, owing to extra functional activity, receive a greater volume of air than normally, and the resonance over these areas is increased.

DIMINISHED RESONANCE, when general, may depend on pulmonary congestion, pulmonary cedema, the presence of a false membrane over the costal pleura or enveloping the lung itself, and interfering with the normal pulmonary expansion.

LOSS OF RESONANCE is not general in the horse and ox except in those cases of 'massive' pneumonia, when a 'wooden' dulness is elicited by percussion. Absence of resonance may be due to hepatization of the pulmonary tissue, or to pleural effusion. It is best marked in the latter condition, and commences in the lower third of the chest. Enlargement of the liver or spleen causes dulness over those portions of the thorax with which these organs are in proximity.

Abnormal Respiratory Sounds.—These include (a) modifications of normal sounds, and (b) adventitious sounds. Of the former there are recognized: (1) Modifications in the bronchial sounds; (2) modifications in the vesicular murmur.

I. MODIFICATIONS IN THE BRONCHIAL SOUNDS.—*Bronchial* breathing is heard over those parts of the chest where normally only the vesicular murmur is audible, and is observed in conditions in which the lung tissue has ceased to contain air, such as in pneumonia, and in collapse or compression of the lung in cases of pleuritic effusion. In these instances the bronchial tubes are surrounded by solid tissue or by fluid, hence the sounds are well conducted, while sounds which originate in the parenchyma are masked.

The bronchial sounds may be altered in character, and

the modifications are described as tubular, blowing, and cavernous.

Tubular.—This is higher in pitch than the normal bronchial sound; it is heard to perfection over a hepatized lobe in pneumonia, and appears to originate immediately beneath the part examined.

Blowing.—The sounds are less concentrated, and appear to be produced at a distance and in a wider tube.

Cavernous.—The sound is generally heard over cavities in the lung, such as occur in tuberculosis and in circumscribed gangrene, but is also produced when solid tissue exists between the base of the lung and the surface. The sound resembles that made by blowing into a wide-mouthed vessel. The inspiratory and expiratory sounds are of a hollow, whiffing character, and lower pitched than in tubular breathing.

2. MODIFICATIONS IN THE VESICULAR MURMUR.—The vesicular murmur may be exaggerated or harsh over a portion of normal lung when another portion of the organ is compressed or solidified, or when the other lung is so affected. It is diminished in conditions in which feebleness of the movements of the thorax exists, such as weakness and prostration. In instances in which the inspiratory act is attended by pain, as in the early stages of pleurisy and in peritonitis, the chest is not fully distended, the respirations are short and quick, and the respiratory murmur is also diminished. Absence or suppression of the vesicular murmur occurs in cases of such conditions as hepatization of the lung in pneumonia and pleuritic effusion. In the latter condition the absence of sound is observed in the lower part of the chest, and its extent corresponds with that of the fluid.

Adventitious Sounds.—During the course of a number of diseased conditions of the lungs and pleuræ the respiratory murmur is accompanied by certain adventitious sounds. These are known as—(1) Rhonchi; (2) Râles; and (3) Friction sounds.

1. RHONCHI, OR DRY SOUNDS.—These are sometimes termed 'dry râles.' They are continuous sounds, and accompany inspiration and expiration. According to their pitch, they are classified as sonorous and sibilant.

Sonorous Rhonchi are low-pitched and of a cooing or snoring character.

Sibilant Rhonchi are high-pitched and of a whistling character.

Rhonchi are produced by the passage of air through bronchial tubes which are narrowed or constricted at some point. The constriction may depend on various factors, such as the presence of viscid mucus, tumefaction of the bronchial mucosa, or spasmodic contraction of the tubes as in asthma.

2. **RÂLES, OR MOIST SOUNDS.**—These include crepitation and various forms of moist râles.

Crepitation, Crepitant or Vesicular Râles.—These terms are applied to the crackling, or very fine sharp sounds, heard during inspiration only, and usually towards the termination of the act. They may be imitated by rubbing a lock of hair between the fingers close to the ear. Crepitant râles are heard in the first stage of pneumonia, and depend on the sudden expansion of alveolar walls which have become adherent by viscid secretion. In this condition air can still enter the alveoli.

Mucous Râles, also known as ‘simple bubbling râles,’ vary in extent. They are produced in bronchial tubes or in cavities in the lung by the passage of air through mucus or serous fluid, and are modified by coughing, thus differing from the crepitant râles.

3. **FRICTION SOUNDS.**—These may be detected in the early stages of pleurisy, and depend on dryness of the pleural surfaces and the deposition upon them of coagulated lymph. They vary from a slight grating sound to a crackling or creaking sound, such as is produced by rubbing together two pieces of leather, and occur as a rule with each inspiration only, being best heard at the lowest part of the chest. They disappear when pleural effusion takes place, but may reappear during the stage of absorption. They are rarely well marked, and are frequently overlooked in veterinary practice.

It may be remarked that, in auscultating the chest of a cow suffering from advanced tuberculosis, we can usually determine a number of the abnormal sounds described.

Palpation.—In the early stages of some cases of pleurisy the friction produced between the pleural surfaces may be manifested by vibration of the thoracic walls, which is perceptible to the touch. Under similar conditions, firm pressure applied to the intercostal spaces over the affected region causes pain. But it must be remembered that in nervous horses with thin skins this manipulation is frequently resented, and such resentment may be mistaken for signs of pain.

Alterations in the Visible Mucous Membranes.

Marked Redness and Deep Congestion of the nasal mucosa and conjunctiva is observed in acute inflammatory affections in the horse. In the normal condition these membranes are pale red in colour. In subacute obstruction of the double colon they are of a deep red hue, and not infrequently tinged with yellow, while in acute enteritis they are of an intense vivid red colour. In acute respiratory affections, when imperfect aeration of

the blood is present, the visible mucosæ assume a dark, livid hue.

Yellow Discoloration of the Visible Mucosæ may indicate the presence of bile pigments in the blood as in jaundice. A yellow tinge of the visible mucous membranes may be observed in cases of intestinal obstruction, and is also frequently seen associated with pneumonia in the horse.

Pallidity of the Visible Mucosæ is met with in anæmic conditions. In internal hæmorrhage, blanching of the membranes is marked.

The nasal mucosa shows petechial spots in purpura hæmorrhagica, and is one of the seats of the characteristic ulcers of glanders.

Alterations in the buccal mucosa will be considered in connection with disorders of the digestive organs.

Symptoms associated with Digestive Disorders.

Anorexia.—LOSS OF APPETITE is probably the commonest symptom met with in practice, and is usually the first sign of illness observed by the attendant. It must be distinguished from inability to feed and from difficulty in feeding. Thus, an animal may be avid for food, and yet be unable to feed because of abnormal conditions of the mouth, pharynx, or cesophagus. Interference with the prehension of food may result from paralysis of the lips, or from spasm of the masseter muscles (trismus), such as occurs in tetanus, and from injuries to the tongue. Dental irregularities interfere with the proper mastication of the food, and, as a result, the animal feeds slowly and with difficulty. In severe trismus mastication is impossible.

Glossitis, the various forms of stomatitis, and the lodgment of a foreign body between the molar teeth, also interfere with mastication. Difficulty in deglutition occurs in acute pharyngitis and laryngitis.

De glutition may be impossible in tetanus because of pharyngeal spasm. Inability to swallow also occurs as the result of a foreign body in the pharynx or in the cesophagus, and in various conditions of this organ, such as paralysis, spasm, 'dilatation-constriction,' and rupture.

Unless there be clear evidence of the existence of a disease accountable for the anorexia, a careful examination of the mouth and teeth should always be made with the aid of a mouth speculum.

Anorexia is usually present in acute febrile conditions, as well as in catarrhal affections of the gastro-intestinal tract. In very acute nasal catarrh, whether or not associated with in-

fluenza, we may presume that in the horse, as in man, temporary loss of the senses of smell and taste occurs, and this contributes to the loss of desire for food. In acute painful conditions, such as septic arthritis, loss of appetite is often evident, but it is not uncommon to find horses suffering from severe injuries feeding normally.

It is not sufficiently realized by animal attendants that the temporary cessation of appetite which so commonly occurs during the acute phases of disease is a natural defensive phenomenon. The practice of forcible feeding in such cases is wholly to be condemned.

Bulimia—EXCESSIVE APPETITE.—This is observed in cases of intestinal parasitism, and although large amounts of food are consumed, the animal remains in poor physical condition. In that affection known as 'broken wind' in the horse there is frequently an excessive desire for food; the animal eats his bedding, and after a time marked enlargement of the abdomen occurs. It is highly probable that, in many cases, a functional derangement of the stomach initiates the affection.

In the dog an abnormal appetite occurs in cases of intestinal parasitism, and in diabetes mellitus.

Pica—DEPRAVED APPETITE.—This is observed in some cases of gastric indigestion. In this condition the horse eats clay whenever opportunity offers, and may even consume his own feces; he may also lick the walls of his stall and the manger. Such acts suggest excessive acidity of the stomach, especially since the administration of alkalis overcomes the condition; on the other hand, the alkaline substances for which the animal craves may not be required as antacids, but may represent minerals in which the food is deficient.

In cattle a depraved appetite is very common, and the tendency for such animals to ingest foreign bodies of every description is well known.

Thirst is a symptom met with in febrile conditions, gastric derangement, dyspepsia, and diabetes. In cattle and sheep suffering from parasitic gastritis, excessive thirst is a prominent symptom.

Salivation.—An excessive flow of saliva is observed in various affections of the mouth, such as stomatitis, glossitis, and dental irregularities; it may also result from irritating medicaments such as oil of turpentine, preparations of ammonia, and chloral hydrate administered in the form of a draught and insufficiently diluted.

In such a condition as acute pharyngitis, the salivation may be due, not to increased salivary secretion, but to inability to swallow. Excessive salivary secretion is induced by certain

drugs, such as arecoline, pilocarpine, and by the long-continued administration of salts of mercury (hydrargyrism).

Fœtor Oris.—This condition is represented by fetid emanations from the mouth. It is observed in ulcerative stomatitis, alveolar periostitis, dental caries, septic wounds of the tongue, etc. Conditions in which particles of food accumulate in the mouth and undergo putrefaction are accompanied by fœtor oris.

As the horse breathes only through the nostrils, fœtor oris cannot be termed 'foul breath' in this animal. The condition in the horse may depend on caries of a molar tooth, disease of the turbinated bones, a septic condition of the bronchial secretions, septic or gangrenous pneumonia.

Fœtor oris is of common occurrence in the dog, in which it is frequently associated with pyorrhœa.

Decrease in the Salivary or Buccal Secretions.—This is a symptom met with in various acute febrile conditions, in inflammatory diseases of the gastro-intestinal canal, in super-purgation, and in diabetes. It also results from the administration of belladonna.

Alterations in the Character of the Buccal Mucosa.—In cases of dyspepsia, especially those associated with hepatic disorder, the buccal mucosa of the horse is frequently covered with an acid, pasty film. A coated or furred tongue, which is so common in digestive disturbances in man, is not observed in the horse. In the dog, a whitish soapy deposit occurs on the tongue and gums, with heavy tartarous deposit on the teeth. A dark-brown, evil-smelling film is often observed on the teeth of dogs suffering from severe 'intestinal toxæmia.'

Abdominal Pain.—Pain is an important symptom, and one that is readily observed by the animal attendant. Pain is the most obvious symptom in acute disorders of the stomach and intestines of the horse, and its occurrence in this animal is readily associated in the lay mind with colic. But so-called 'colicky pains' may be observed in diseases of the liver, kidneys, and in the early stages of pleurisy and of azoturia, while in pregnant animals they may arise from premature labour pains.

Acute pain occurs in such conditions as acute laminitis, septic arthritis, and in severe wounds involving the deep structures of the foot, but in such instances the horse does not exhibit symptoms similar to those of abdominal pain, such as lying down, rolling, etc. Instead of these we observe greatly accelerated respirations, disinclination for movement, dilated nostrils, an anxious expression of countenance, sweating, and occasionally groaning.

In order to draw deductions from abdominal pain as a symptom we must first observe its character—*i.e.*, whether intermittent

or continuous, acute or dull—and associate our consideration of it with whatever alterations we find in the pulse, respirations, and temperature. We have then to consider the evidence obtained from a careful rectal exploration, and so endeavour to interpret the clinical picture thus formed. Acute pain manifested by violent symptoms is not uncommon in cases that ultimately recover, while only dull pain may accompany morbid conditions that terminate fatally.

Abdominal pain may be *acute* and *intermittent*, evidenced by the horse pawing vigorously, throwing himself down violently, rolling, looking towards his flanks, stamping with the hind-feet. These symptoms appear in paroxysms, and are met with in the affection termed 'simple spasmodic colic.'

Pain may be *acute* and *persistent*, no intervals of ease being observed. This type occurs in acute enteritis and in the earlier stages of volvulus.

Pain may be 'dull,' when the animal shows uneasiness, walks about his stall, paws occasionally with the fore-feet, or stamps the ground with the hind-feet. When lying down, he does so carefully, after several crouching movements, and stretches himself out, emitting a deep sigh or a long-continued groan. The recumbent position may be assumed for a variable period, during which he looks frequently towards his flank. The inspiratory movement is prolonged, and expiration is heaving and accompanied by a sigh or groan. He next rises again to his feet, and the symptoms are repeated. This type of pain is continuous, and is met with in cases of impaction of the double colon and allied conditions.

Acute intermittent pain may be followed by the persistent form, while 'dull' pains may rapidly increase in intensity during the course of an attack of colic.

Sudden cessation of abdominal pain in a case that previously showed violent symptoms, if associated with a pulse becoming gradually imperceptible, cold sweats, and a haggard expression of countenance, must be regarded as a fatal prognostic sign. When occurring in cases of volvulus or enteritis, it indicates the development of necrosis in the inflamed portion of intestine. It is also observed in the later stages of cases of intestinal and gastric rupture. In the so-called 'spasmodic colic' there occurs a spasmodic contraction of some portion of the colon. The condition may be unassociated with impaction. In obstructive colic due to impaction the pain arises from a spastic condition of the bowel wall which develops over the site of obstruction.

Pain in acute gastric and intestinal affections has its origin in increased tension on the muscular wall of the viscus due to

excessive contraction or distension, the stimulus being conveyed by the autonomic nerves to the spinal cord, and thence referred to that area of the body surface supplied by the corresponding spinal nerve ('referred pain').

Physical Examination of the Abdomen.—The evidence obtained from an examination of the abdomen by inspection, palpation, percussion, and auscultation may here be briefly discussed.

INSPECTION.—A contracted condition of the abdominal muscles, giving the animal a 'tucked-up' appearance, is observed in the early stages of enteritis and peritonitis. Distension of the abdomen occurs in some cases of tympanites and ascites (see below). Enlargement of the abdomen is usually seen in 'broken wind.'

PALPATION.—A hard, tense condition of the abdominal walls is met with in painful intestinal affections such as enteritis.

The manifestation of pain on pressure may be regarded as a symptom of importance, but in the horse, especially in nervous animals, there is considerable difficulty in distinguishing the uneasiness and restlessness produced by palpation from evidences of existing pain. Owing to the thickness and firmness of the abdominal walls in the horse, and the large extent of the viscera, it is not possible to locate definite painful areas or seats of obstruction with facility, as can be done in the dog and cat.

PERCUSSION.—Abdominal percussion is mainly employed in the horse and in cattle for the purpose of determining the presence of tympanites. The condition occurs in the stomach or in the large intestines of the horse, and in the rumen of the ox and sheep. It is evidenced by a clear, drum-like sound on percussion, and by a tense condition of the abdominal walls on palpation. In extreme cases the distension is evident by simple observation. Tympanites varies in degree: in tympany of the stomach of the horse, because of the situation and comparatively small size of the viscus, the abdominal distension is not well marked, while in acute intestinal tympany it may be very extensive. It also assumes large dimensions in cases of tympany of the rumen in the ox.

Tympanites may occur early, as in flatulent colic; or it may not appear until the later stages of the case, as in acute enteritis and peritonitis. It must always be regarded as a serious symptom, especially when occurring in the later stages of an attack of colic. Cases, however, of fatal intestinal colic are met with in which tympanites may be absent during their entire course. In the dog and cat, abdominal percussion is chiefly employed for the detection of increased hepatic dulness and the presence of dropsical effusions.

AUSCULTATION.—By auscultating the flanks we obtain evidence of the presence or absence of peristaltic sounds. Absence of these points to a static condition of the intestines, such as occurs in some forms of acute intestinal obstruction.

Evidences obtained by Rectal Exploration.—This procedure should never be neglected in abdominal affections, and in all instances in which abdominal pain of obscure origin is manifested. Owing to the large calibre of the rectum in the horse, very valuable evidence can be obtained by rectal exploration. The student must make himself familiar with the normal condition and situation of the organs capable of rectal palpation by performing rectal explorations in the normal animal. Rectal exploration, like all diagnostic methods, must be intelligently and carefully performed. The hand and arm of the operator being anointed with a suitable lubricant, all the faeces within reach are removed from the rectum, and the hand is then gently inserted as far as possible, and the organs within reach carefully palpated. The character of the faeces is to be noted—*e.g.*, whether semi-fluid, or hard and solid, or covered with mucus, or composed of undigested material. The condition of the rectum next claims attention. In cases of obstruction of the intestines depending on various causes, the rectum is found either dilated ('ballooned'), or it may exert a 'clinging' action on the arm of the examiner, in which case severe straining on the part of the patient may also be exhibited.

By palpation towards the left and centre the pelvic flexure of the double colon can be located, and towards the right will be felt the head of the cæcum and the large colon. Under normal conditions the pelvic flexure does not occupy the pelvic cavity, but is situated just anterior to the brim of the pelvis.

In subacute obstruction of the double colon the impacted intestine is found on palpation to be solid in consistence, or easily indented by pressure with the fingers, and in some instances a moderate degree of tympany is present. The rectum is 'ballooned,' and the animal may strain violently against the operator. In obstruction of the pelvic flexure due to impaction, this structure is found within easy reach as a round object, hard in consistence. In severe cases the distension is marked and the pelvic flexure extends into a more central position than is the case under normal conditions. In impaction of the cæcum the distended organ is located in the lumbar region, near the centre of the abdomen, lying mainly on the right side, but projecting slightly over the median line. In impaction of the single colon, the impacted portion of the intestine may be occasionally located. It may be found that digital pressure on the intestine causes pain; the

animal crouches, and may even lie down if manipulation be continued. In other cases manipulation of the impacted bowel, instead of being resented, appears to afford some degree of relief.

Intestinal calculi can be located if situated in the pelvic flexure of the large colon or in the small colon.

In displacement of the pelvic flexure of the large colon, due to bends or flexions, the diagnosis is based on the presence of a soft, depressible mass in the pelvic cavity; on manipulation part of this mass can be forced forward into the abdominal cavity, but on withdrawing the pressure the pelvic flexure is returned to the pelvic cavity. In torsion or displacement of the pelvic flexure no portion of the colon can be located, but in many instances a distended coil of small intestine, easily mistaken for the pelvic flexure, is detected in the pelvic cavity. In this, as in other conditions of acute obstruction, the rectal walls exert a 'clinging' action on the arm of the operator, and violent straining is exhibited.

The diagnosis of strangulated scrotal hernia is based on an examination *per rectum*.

In newly-born foals impaction of the rectum due to the retention of meconium is recognized by a digital examination.

Among other abnormal conditions recognized by rectal exploration are distension of the bladder, the presence of a vesical calculus, abdominal tumour or mesenteric abscess, if within reach; thrombosis of the external or internal iliac artery, pelvic fractures, and the existence of pregnancy.

In bovines rectal exploration is employed to determine the existence of pregnancy in the earlier months of gestation; the presence of pelvic hernia in bullocks; intra-abdominal tubercular lesions may also be palpated.

In the dog digital examination of the rectum may indicate the presence of faecal obstruction, abdominal neoplasms, distension of the bladder, enlargement of the prostate gland, etc.

Certain Attitudes and Postures assumed by the Patient.—Although these are sometimes suggestive signs, they cannot be regarded as diagnostic of specific conditions.

TURNING OF THE HEAD TOWARDS THE FLANK is a symptom met with in several conditions in which abdominal pain is present.

LYING ON THE BACK, with the feet against the sides of the stall, and maintaining this posture for several minutes, is often observed in the horse in cases of volvulus, but may also occur in conditions of very acute abdominal pain arising from simple functional aberration.

SITTING ON THE HAUNCHES, which is a normal position in the dog, is a serious symptom in the horse. It occurs in acute intestinal obstruction and in acute gastric tympany, but does not necessarily, as was at one time generally believed, indicate the approach of a fatal termination.

LYING ON THE STERNUM with both fore-legs extended is occasionally observed in acute gastritis in the horse.

WALKING IN A CIRCULAR DIRECTION in the loose-box (the 'circus mode of progression') is commonly regarded as a symptom of persistent abdominal pain, such as occurs in acute enteritis. But while horses suffering from abdominal pain may, in many instances, walk about dejectedly in an aimless manner, circular movements commonly result after large and repeated doses of opium or morphine have been administered for the relief of pain. These movements are occasionally observed in cerebral affections in the horse, ox, and dog, while in the sheep they occur as the result of the presence of *Cæmurus cerebrealis* in the brain.

EFFORTS AT MICTURITION.—Commonly a horse, the subject of colic, adopts a posture suggestive of that assumed by the male during micturition; the weight of the body is thrown forward on to the fore-legs, the hind-legs being somewhat extended in a backward direction. This posture, which is seen in both sexes during attacks of colic, especially those due to impaction of the large bowel, appears to afford a certain measure of relief from pain, but it is commonly supposed to indicate inability to micturate.

FORCING THE HIND-QUARTERS AGAINST THE SIDES OF THE STALL is observed in impaction of the large colon.

Constipation.—This symptom is exhibited in many affections. It varies in degree, from a condition in which the fæces are less in amount and firmer in consistence than normal, to one in which fæcal obstruction of the intestine is present. In arriving at a diagnosis in intestinal affections, it is very important to ascertain the presence or absence of fæcal obstruction. If the fæces are passed in normal amount it is a favourable sign; on the other hand, obstinate stasis of the intestines is always to be regarded as serious. Fæces may be expelled in an apparently normal manner at the commencement of some fatal bowel affections, such as impaction of the cæcum, in which diarrhoea may even occur in the early stages, and an erroneous diagnosis or prognosis is likely to be given unless the general symptoms are taken into consideration.

Diarrhoea.—This symptom varies in degree, and, like constipation, is met with in various intestinal disorders. Diarrhoea may be a premonitory symptom in enteritis, in impaction of the

small intestine, and of the cæcum, and thus prove a misleading symptom.

Vomiting.—In carnivora this is a symptom common to many affections. It is readily induced by direct irritation of the gastric mucosa, and also occurs reflexly through irritation of some other organ—*e.g.*, the uterus in pregnancy, and metritis. In the horse vomiting is of comparatively rare occurrence, and it cannot be induced as a therapeutical measure by the employment of emetics.

Vomiting in the horse may or may not be accompanied by nausea. In some cases the ingesta are discharged in small amounts from one or both nostrils, and occasionally the animal makes an effort, by depressing the head, to facilitate expulsion. In other instances the expression of the animal is indicative of extreme nausea while emesis is in progress. The amount discharged may be very considerable, or, after repeated attempts at vomiting, only a small quantity of fluid is emitted. Occasionally, when the quantity is large, it is discharged by the mouth as well as by the nostrils. During the act the muscles of the abdomen and neck may be spasmodically contracted, and the head drawn towards the sternum. In some instances emesis is accompanied by very considerable forceful movements (straining and retching), and by profuse salivation. Sweating may also be observed, and during the intervals exhaustion, trembling, and coughing may be exhibited. Vomiting is a frequent symptom of rupture of the stomach. Authorities differ as to whether the act occurs prior or subsequent to the gastric rupture; but vomiting may be met with in conditions which are not necessarily fatal, such as impaction of the stomach, dilatation of the thoracic portion of the œsophagus, or the presence of a diverticulum close to the termination of the œsophagus in the stomach. In constriction of the œsophagus all the phenomena of vomiting may be present, but the material expelled does not proceed from the stomach, being simply ingesta which has become lodged in the œsophagus.

In addition to rupture of the stomach, there are other fatal conditions in which vomiting may occur—*viz.*, impaction of the small intestine, twists of the intestine, rupture of the intestine, and rupture of the diaphragm. Vomiting also occurs as one of the symptoms in poisoning by aconite and rhododendron, and is occasionally observed after the administration of physostigmine, arecoline, and barium chloride.

Eructations and Regurgitation.—These are important symptoms in the horse, and their presence generally indicates the existence of an acute gastric disorder; they may also be

observed in torsion of the double colon. Even in extreme gastric tympany, regurgitation or eructation seldom occurs, because of the firm contraction of the cardiac orifice of the stomach.

ERUCTATIONS are manifested by the expulsion of small quantities of gas through the nostrils, and they may be accompanied by contraction of the cervical muscles and by readily audible gurgling sounds in the œsophagus. In some cases a distinct hiccough may be heard with each eructation. In gastric tympany, eructations may be regarded as favourable signs, as the dangerous gaseous distension is, at least to some slight degree, relieved by this means.

REGURGITATION of small amounts of fluid may accompany the eructations in some cases, and distinct contractions may be observed passing upwards along the course of the œsophagus. The fluid may contain small quantities of ingesta, and be expelled through the nostrils, in some instances without apparent effort. In others there are evidences of nausea, the head is slightly depressed during the act, a squeal is emitted, and actual vomiting occurs.

Symptoms associated with the Urinary Organs.

Although a number of symptoms are met with in diseases of the kidneys, none can be regarded as diagnostic, and frequently diagnosis can be made only by the aid of chemical and microscopical examination of the urine. On the other hand, there are surgical affections of the urinary passages in which physical means of diagnosis are available. Again, there are affections, such as diabetes mellitus and hæmoglobinuria, in which morbid alterations occur in the urine in the absence of any primary disease of the urinary organs.

Formerly, diseases of the kidneys in the horse were regarded as of common occurrence, but the symptoms on which such opinions were based are common to a number of different affections. Thus, frequent attempts at micturition, an excessive or a diminished flow of urine, with alterations in its colour and appearance, may occur in the absence of a renal affection. On the other hand, chronic disease of the kidneys may be present without the occurrence of any well-marked symptoms attributable to these organs, and its existence can only be determined by an examination of the urine.

In the present section attention will therefore be drawn only to the morbid changes occurring in the urine, the methods by which these can be detected, and to the general symptoms of renal

diseases. In all cases manifesting obscure symptoms an examination of the urine should be carried out.

The student should be familiar with the characters of the normal urine of the various animals, and the data in the table on this page are of importance to the clinician.

The urine of the horse is generally turbid in appearance, due to suspended carbonate of lime and magnesia, and the turbidity becomes intense as the urine cools, especially when ammoniacal fermentation takes place. The colour may be clear yellow, brownish-yellow, deep yellow, or yellowish-red; on exposure to air it rapidly changes to brown. It is influenced by certain forms of diet; thus, on green food it may be yellowish-white, and if large amounts of red carrots be allowed it may be of a brownish-red tint. Some mares normally excrete a glairy tenacious urine containing a large amount of mucus, and, especially during œstrum, it may be found as thick as linseed-oil.

	<i>Reaction.</i>	<i>Specific Gravity.</i> (Water=1000)	<i>Quantity.</i>
Urine of horse	Alkaline. If fed entirely on oats, becomes acid.	Average, 1036.	Varies according to diet, amount of water consumed, season, and work. Increased on highly nitrogenous diet and in winter; lessened in horses at work and in warm weather.
Urine of ox	Alkaline. In suckling calves, acid.	1007 to 1030.	Larger than in horse—10 to 40 pints in 24 hours.
Urine of sheep	Alkaline.	1006 to 1015.	0.5 pint to 1.5 pints in 24 hours.
Urine of pig	Acid or alkaline.	1003 to 1025.	2½ to 14 pints in 24 hours.
Urine of dog	Acid on a flesh diet. May be alkaline on a vegetable diet.	1016 to 1060, depending on the diet.	Varies with the size of animal and the nature of the diet, generally estimated at ½ pint to 1½ pints in 24 hours.

Oliguria refers to a diminution in the quantity of urine secreted. It varies in degree, and may be associated with one of the following conditions: (a) Diseases of the kidneys, in which, owing to

shrinkage of the renal capillaries and atrophy of the glomeruli, a diminished amount of blood passes through the organs; also morbid alterations in the secretory structure of the kidneys. (b) Diseases of the heart, in which lowering of the blood-pressure occurs and the renal circulation becomes impeded. (c) Pressure on the renal veins by tumours or by ascitic fluid. (d) Conditions in which large amounts of fluid escape from the body by other routes—the bowels in diarrhoea and the skin in excessive perspiration; also during the formation of extensive exudates and transudates—*e.g.*, pleural effusion, hydrothorax, or ascites. (e) In acute febrile conditions.

Anuria signifies total suppression of urine. It occurs under the following conditions: Obstruction of the urinary passages by calculi; intense congestion in the early stages of acute nephritis; in some cases of severe nephritis, with degeneration of the secreting epithelium, or in occlusion of the collecting tubules due to contraction of new connective tissue surrounding them; in acute poisoning by oil of turpentine, cantharidin, etc.

Polyuria.—This term is applied to an increase in the quantity of urine, especially as regards the proportion of water. It is a symptom occurring in a number of conditions, and the urine may exhibit various morbid changes according to the nature of the disease upon which the condition depends. Polyuria occurs when a larger amount of blood than usual passes through the kidneys unaccompanied by a fall in the renal blood-pressure. This may depend on (a) an increase in the general blood-pressure, which is not associated with constriction of the renal vessels, or (b) on dilatation of the renal vessels, whether or not that be associated with a rise in general blood-pressure. It may also depend on chemical stimulation of the renal parenchyma associated with an increased permeability of the dilated renal blood-vessels.

Polyuria is met with in several forms of renal disease. In chronic interstitial nephritis the explanation of this symptom is not yet definitely determined. Polyuria is a prominent symptom in diabetes insipidus and diabetes mellitus. It may also be observed in certain affections of the central nervous system, in cases of pneumonia and pleurisy when copious exudates and transudates are comparatively quickly absorbed, in certain chronic infectious diseases, such as tuberculosis and glanders, and as the result of large doses of diuretic agents. In order to ascertain the cause of polyuria, the history of the case must be considered, and a chemical and microscopical examination of the urine should be carried out.

Albuminuria.—Minute quantities of albumin may be found

in the urine of healthy animals, especially in dogs and swine, to a less extent in ruminants, and very rarely in horses (Simader). This is termed 'physiological albuminuria.' The albumin found in the urine under normal conditions is, however, chiefly nucleo-albumin and mucin. The presence of albumin in the urine generally indicates some lesion of the renal parenchyma, but it may also be associated with other morbid conditions. In the normal kidney only the water and the salts, together with urea, creatinine, etc., are allowed to pass from the blood. When albumin transudes, the nutrition of the epithelium of the capillaries of the tufts or of the cells surrounding the glomerulus is probably disturbed.

Albuminuria is met with in the following conditions: Acute and chronic organic diseases of the kidneys, in which the glomeruli or the epithelial cells are affected; acute and chronic renal congestion; various diseases of the blood associated with alterations in its composition; certain affections of the nervous system; acute specific diseases; chronic poisoning by lead or mercury; and in the disease known as 'azoturia.'

Spurious Albuminuria is the term applied to conditions in which albumin occurs in the urine, but is not derived from the renal tissue, such as septic affections of the renal pelvis, ureters, and bladder.

The tests for albumin will be found on pp. 35 and 36.

In considering the significance of albuminuria as a symptom, a microscopical examination of the urine should always be carried out (see p. 38).

Hæmaturia signifies the presence of blood in the urine. This may occur under such conditions as follow: It may be met with in association with renal affections such as acute renal congestion, acute nephritis, renal infarction, rupture of the kidney, neoplasms, renal calculus, and the presence of renal parasites. Certain toxic agents, such as oil of turpentine in large doses, carbolic acid, and cantharidin, also cause hæmaturia. Further, calculus in the ureter, vesical calculus, and urethral calculus, tumour or ulceration of the bladder, and injuries due to passage of the catheter, may be associated with the presence of blood in the urine.

CHARACTERS OF THE URINE.—It may be smoky, bright red, or of a dark porter colour. In many instances, in addition to red blood-corpuscles, the urine contains hæmoglobin in solution, owing to the destructive action of the urinary constituents on the corpuscles. This is said to occur more readily in ammoniacal urine, or when the latter is of low osmotic tension. The sediment is light or dark red in colour, and may contain red blood-

corpuscles. In some cases blood-clots are present. On microscopical examination the blood-corpuscles can be recognized with facility; they may retain their colour, and be free or aggregated in masses and may be crenated; or they may be imbedded in casts of the uriniferous tubes.

It is of importance to ascertain the source of the hæmorrhage, but this may be attended with difficulty. When originating from the kidneys, the blood and urine are intimately mixed. But clots may be present, especially in the case of profuse renal hæmorrhage, and occur in the form of moulds of the pelvis of the kidney, or of the ureter. When the bladder is the source of the hæmorrhage, blood may be found only in the last portion of urine passed; but in some well-marked cases of this nature the blood may be intimately mixed with the urine. If the bladder be washed out by instrumental means, the fluid is found more or less blood-tinged; but if the source of the bleeding be the ureter or kidney, the fluid withdrawn is clear. When the hæmorrhage is renal, epithelial cells and various casts may be detected in the urine. When the bleeding occurs from the urethra, due to the presence of a calculus, the blood may escape in the intervals between the acts of micturition, or may appear as a small clot at the commencement of the act, or it may be passed during the straining which accompanies the attempts to urinate.

Hæmoglobinuria.—In this condition hæmoglobin occurs in the urine. It is observed in piroplasmosis, more rarely in trypanosomiasis, and as the result of administering large doses of such drugs as potassium chlorate, phenacetin, naphthalin, etc. Hæmoglobinuria is believed to depend either on a breaking down of the red blood-corpuscles, or on the elimination of the pigment from the blood-cells, or on a combination of these processes. Myoglobin liberated by the rapid breakdown of muscle fibres in the equine disease for long known as 'azoturia' colours the urine in the same way as hæmoglobin, and reacts to the same chemical tests. Myoglobin may be distinguished from hæmoglobin spectroscopically, and the renal threshold of myoglobin is much lower than that of hæmoglobin. In hæmoglobinuria the urine may be red, brownish-red, or porter-coloured, and shows a heavy brownish-red sediment. The tests for the presence of hæmoglobin in the urine will be found on p. 36.

Bile-Pigments in the Urine.—This phenomenon occurs in certain diseases of the liver, and in conditions in which jaundice is a symptom, such as in piroplasmosis. The presence of definite amounts of bile-pigments in the urine is an important indication of hepatic disorder. Traces of bile-pigment in the

urine of the dog may be of very little significance. The tests are described on p. 37.

Glycosuria.—The presence of sugar in the urine is one of the leading features in the disease known as 'diabetes mellitus'—an affection not uncommon in the dog, but of very rare occurrence in the horse. The tests for sugar will be found on p. 37.

Pyuria.—Pus in the urine is met with in renal abscess, purulent nephritis, cystitis, urethritis, uterine or vaginal catarrh, and pyelitis; also in instances in which a pelvic or perirenal abscess ruptures into the urinary passages. Pyuria may be intermittent in the case of large renal abscesses, and continuous in calculous pyelitis. When a pelvic or perirenal abscess ruptures into the urinary passages, a large amount of pus appears in the urine within a short time, and then rapidly diminishes or may cease abruptly. In pyuria the urine is of a white or a yellowish-white appearance, and may be strongly ammoniacal, and the sediment may be ropy in character. On microscopical examination a large number of pus corpuscles are detected; these, when the pus originates in the bladder, are well formed. Associated with the pus are epithelial cells from the bladder and pelvis of the kidneys, but, as these cells resemble each other very closely, it is extremely difficult to determine the source of the pus.

Examination of the Urine.

(A) PHYSICAL.

Specific Gravity. The specific gravity is determined by means of a hydrometer placed in the urine contained in a cylindrical glass vessel. The hydrometer should have a range from 1,000 to 1,090.

(B) CHEMICAL.

Reaction.—The reaction of urine is usually determined by means of litmus paper. More accurate determinations may be made by colour reagents that indicate approximately the pH of a particular sample of urine.

Tests for Albumin.

Heat Test.—A small quantity of urine is heated in a test-tube over a spirit-lamp, and acetic acid is added in sufficient quantity to render the urine faintly acid. If on boiling a cloudiness occurs, which is not dissolved on the addition of more acid, albumin is present. It is generally believed that a precipitate which dissolves is due to earthy phosphates or carbonates, but F. Smith states that phosphates are practically absent from the urine of the horse.

Heller's Ring Test.—Pour a small quantity of fuming nitric acid into a test-tube, and with a pipette allow the urine to flow gently down the side of the tube upon the acid. At the line of junction

of the two fluids a white ring is formed, the depth of which varies according to the amount of albumin present. This test is reliable and convenient for clinical work, and is capable of demonstrating the presence of 0.02 per cent. of albumin. A coloured ring may form at the junction of the acid and the urine, and is due to oxidation of the colouring matters in the urine.

Ferrocyanide of Potassium and Acetic Acid Test.—To a test-tube half full of urine add 1 or 2 c.c. of a 5 per cent. solution of ferrocyanide of potassium. Mix thoroughly and add 10 to 15 drops of acetic acid. If albumin be present, a cloudiness or a flocculent precipitate will be produced, the degree of which varies according to the amount of albumin present. This test precipitates all forms of albumin, but does not precipitate mucus, and may be regarded as reliable.

Trichloroacetic Acid Test (after Raabe).—This is also advised for the detection of minute traces of albumin, and is carried out as follows: Add a small crystal of trichloroacetic acid to 1 c.c. of urine. If albumin be present, a sharply defined turbid zone occurs at the point of contact.

Salicyl-Sulphonic Acid Test (of Roch).—This is also advised by Henn for testing the urine of horses and cattle. Add a few crystals of salicyl-sulphonic acid to 2 or 3 c.c. of urine. If albumin be present turbidity results. A very convenient method of applying this test has been introduced by Messrs. Fletcher and Co., Holloway, London. The reagent is contained in an 'endolytic' tube. A few drops of the suspected urine are transferred to a quarter-sheet of note-paper by means of a folded strip of paper. The end of the endolytic tube is allowed to touch one of the drops of urine, when the latter will be absorbed into the reagent by capillary attraction. If a precipitate forms, heat the tube in boiling water or by means of a wax vesta. If the precipitate remain, albumin is present; if it disappear, it may be concluded that albumose forms the precipitate, and that it is not attributable to a renal affection.

Quantitative Estimate of Albumin.—For an accurate estimate, Esbach's albuminometer must be employed. (See works on urine analysis.)

A rough method consists in boiling a certain amount of acidulated urine in a test-tube, and allowing it to stand until cool. By comparing the depth of the deposit with the whole amount of urine in the tube, an approximate idea may be gained of the amount of albumin present, such as 'a mere trace,' 'one-fourth,' 'one-half,' etc.

Tests for Hæmoglobin.

Spectroscopic Test.—This is specially suitable for demonstrating the presence of oxyhæmoglobin and methæmoglobin. In the case of the former two absorption bands will be present, while in the latter three absorption bands will be observed, the one in the red being characteristic.

Chemical Test.—To a few c.c. of urine in a test-tube add 2 drops of a fresh tincture of guaiacum and mix; then layer on top of this 1 c.c. of ozonic ether. The presence of hæmoglobin will give a blue colour at the interface.

Tests for Bile-Pigments.

Gmelin's Test.—A portion of the suspected urine is slowly added to some nitric acid containing a few drops of nitrous acid, so that the urine forms a layer above the acid. If bile-pigments be present, a play of colours is observed where the liquids meet, green being most marked.

The presence of bile-pigments in horse's urine is difficult to demonstrate by Gmelin's test, as a dark brown zone is formed which obscures to a great extent the green tint. It is advised that the urine be diluted with water, and then mixed with a solution of baryta, and allowed to stand for twelve to twenty-four or forty-eight hours. Gmelin's test is then applied to the clear supernatant fluid. The colour reaction, however, is not well marked.

Rosenbach's Test.—This is a modification of Gmelin's test. A quantity of the urine is filtered, the filter-paper is dried in air, and then laid on a plate or piece of glass, and touched with a glass rod previously dipped in fuming nitric acid. If bile-pigments be present, a ring of colours is observed at the point of contact. These colours from within outwards are yellow, violet, brown, and green. The green colour only is obtained in some cases.

Tests for Sugar.

Fehling's Test.—Two solutions are required. No. 1 contains copper sulphate, 303½ grains; sulphuric acid, 5 minims; distilled water, sufficient to make 10 ounces. No. 2 contains caustic soda, 1 ounce 236 grains; sodium and potassium tartrate, 3 ounces 228 grains; distilled water, up to 10 ounces. Immediately before use, equal parts of No. 1 and No. 2 are mixed together and boiled till the solution assumes a uniform deep-blue colour. A quantity of urine equal to that of the resultant solution is boiled, and the boiling urine is poured into the Fehling's compound solution and the whole brought to the boil.

If sugar be present, the yellow suboxide of copper is thrown down as a precipitate.

Prolonged boiling of the mixture of urine and Fehling's solution must be avoided, as fallacies may appear due to the presence of glycuronic acid, a compound that has the power of reducing Fehling's solution, though more slowly than sugar.

Glycuronic acid is normally present in substantial amounts in the urine of horses and cattle. It is present only in small amounts in the urine of dogs, but may be present in considerable amounts after the administration of drugs such as aspirin, camphor, cannabis indica, chloral hydrate, chloroform, morphine or phenacetin.

The possibility of error due to the presence of glycuronic acid may be avoided by using Nylander's test.

Nylander's Bismuth Test.—Nylander's solution is prepared as follows:

Sodium and potassium tartrate, 4 grammes . . .	} 100 c.c.
Sodium hydroxide, 10 grammes	

Dissolve.

Next add 2 grammes of bismuth subnitrate, and digest in a hot-water bath until as much as possible of the bismuth salt is dissolved.

TO APPLY THE TEST.—Add 1 c.c. of this solution to 10 c.c. of the suspected urine, and boil for five minutes. If sugar be present, a black deposit of bismuth occurs, this being due to the reduction of the subnitrate to the metallic bismuth.

This reagent is not reduced by glycuronic acid, and it may therefore be used in testing for the presence of sugars in dog urine.

Fermentation Test.—This is regarded as the most accurate and reliable test for sugar. A small fragment of yeast is placed in a test-tube full of the suspected urine. The test-tube is then inverted over a glass vessel also containing urine. If sugar be present, fermentation occurs, and carbon dioxide is formed, which accumulates in the upper part of the tube, and expels the urine therefrom. Specially devised fermentation-tubes can be obtained for carrying out this test.

Tests for Acetone.

Rothera's Test.—A test-tube is filled about one-third full of urine saturated with ammonium sulphate; to this is added a few drops of a freshly prepared 5 per cent. solution of sodium nitro-prusside. Strong solution of ammonia is then either added or run on to the surface to form a layer. If acetone be present a brilliant permanganate colour develops in the whole or at the junction of the two layers.

(C) MICROSCOPICAL.

This procedure is carried out in order to detect the presence of organized casts, epithelium, etc. The presence of pus or blood in the urine is also determined by this means.

Organized Casts in the Urine.—A 'cast' is the term applied to a model of a hollow organ, such as a renal tubule, and is formed by effused plastic material. The presence of organized casts in the urine indicates an acute or chronic inflammation of the kidneys.

Clinical Significance of Casts.—If epithelial and blood casts, with a large amount of renal epithelium, be found, they point to the presence of an acute nephritis; oil-drops in the epithelium, or scattered over hyaline casts, indicate fatty changes in the kidney. The presence of casts in hæmaturia or pyuria suggests a renal origin for the blood or pus.

Epithelium in the Urine.—This may be derived from the uriniferous tubules, the renal pelvis, the ureters, the bladder, the urethra, or the vagina. The source may be determined by the prevailing type of cell, by the presence or absence of casts, and by the accompanying symptoms. When the epithelial cells are detached without change of form, the seat of desquamation may be ascertained by microscopical examination of the urine. Thus, when numerous, large, and squamous, the epithelial cells are probably derived from the bladder. If they originate from the renal pelvis or ureters, they are also squamous, but not so

large or so numerous. If polyhedral with large nuclei, or columnar, they are probably derived from the uriniferous tubules; and if from the male urethra they are generally columnar. But in cases of catarrhal inflammation of the mucosa these cells are generally passed in large amounts, and tend to assume a common form—viz., globular with large nuclei—so that their source cannot be definitely determined. Again, after the cells have become soaked in the urine, it may not be possible to differentiate them.

General Symptoms of Renal Diseases.—The effects of renal disease are often far-reaching, and involve disturbance of the digestive, circulatory, respiratory, or nervous system. Although the symptoms presented in renal diseases in the horse are generally obscure, yet there are certain clinical phenomena which suggest an affection of the kidneys, and lead the practitioner to examine the urine. It is desirable to carry out several examinations of the urine, as a single examination may demonstrate only slight abnormalities which may be regarded as insignificant. Further, by repeated examinations it may be determined whether the morbid alterations discovered are temporary or permanent. In obtaining samples of urine for examination, precautions should be adopted to avoid contamination which may arise from an unclean catheter or from a dirty vessel.

The following symptoms may be presented in diseases of the kidneys: A stiff or straddling gait in the hind-limbs, difficulty in lying down or rising, or in turning round; arching of the back, obscure colicky pains. In the early stages of acute nephritis, the urine may be high-coloured, passed in small amounts at frequent intervals, or actually suppressed. In chronic nephritis, frequent micturition and the passage of large quantities of urine of low specific gravity may be observed. In the later stages of renal disease associated with uræmia, the animal may assume the recumbent position and be unable to rise. Convulsions may also be manifested. Pain on deep palpation over the kidneys is popularly considered to be a symptom of renal disease, but many healthy horses will flinch if pressure be applied to the lumbar region. Rectal examination will in some cases enable us to detect enlargement of the kidneys (nephrauxie) and tenderness on palpation (nephralgia). Among the constitutional symptoms which may be observed there occur capricious appetite, thirst, emaciation, evidences of dyspepsia, swollen limbs, debility, anasarca in the sternal and abdominal regions. Ascites is rarely met with in the horse.

In the dog, chronic renal disease frequently occurs in the absence of manifestation of clinical symptoms.

In the cat, when the kidneys are enlarged, the condition can be detected by palpation of the abdomen.

Dysuria signifies difficulty in micturition. It depends on any condition which interferes with the passage of urine, such as calculus in the bladder or in the urethra, stricture of the urethra, paraphimosis, or phimosis. It is evidenced by frequent attempts at urination, and a varying degree of restlessness and pain.

Strangury is the term applied to painful imperfect micturition, accompanied by straining and the frequent passage of small amounts of urine. It is observed in acute inflammation of the bladder, especially when the affection is due to the toxic effects of irritant drugs such as oil of turpentine or cantharidin.

Retention of Urine may occur in various disorders, such as calculi in the bladder or urethra, polypoid tumours obstructing the neck of the bladder, enlargement of the prostate gland, paralysis of the bladder, spasm of the sphincter vesicæ, tetanus, and in spasmodic colic. In male animals, conditions which bring about inability to assume the attitude necessary for micturition, such as paraplegia, may lead to retention of urine. The condition is evidenced by complete absence of micturition (ischuria), or very small amounts of urine may be passed, accompanied by pain and associated with frequent attempts at micturition. In the dog and cat urgent symptoms may be absent, and the condition may be overlooked, with serious consequences, unless a careful examination of the abdominal cavity be carried out by palpation. In post-parturient decubitus in cows, retention of urine is commonly exhibited.

Incontinence of Urine.—In this condition the bladder is unable to retain the urine, and the latter is passed in an involuntary manner. The condition may be met with in cystitis, and in certain spinal diseases accompanied by paralysis of the sphincter vesicæ. It is of common occurrence in young dogs.

The Nervous System.

Our knowledge of diseases of the nervous system in animals is very limited; this is largely due to our patients being unable to furnish us with subjective symptoms.

Apart from acute functional disorders, diseases of the nervous system are of comparatively slight importance to the veterinary practitioner. When, as the result of a nervous affection, a horse's capacity for work is materially reduced, it may be necessary to advise destruction. In canine practice, where economic considerations do not apply, a prolonged course of treatment

may be undertaken unless the circumstances are such that destruction is the more merciful course.

It should be observed that while acute nervous phenomena are exhibited in association with inflammatory conditions of the brain and cord, similar symptoms are often manifested in the absence of involvement of the central nervous system—for example, the nervous symptoms observed in cases of impaction of the stomach in the horse (the so-called 'stomach staggers'), the excitement and delirium manifested in some cases of acute gastritis in cattle, the nervous phenomena of milk fever, and the reflex epileptiform convulsions in the dog which result from the presence of foreign bodies or parasites in stomach and intestines. Many of such instances depend on reflex nervous irritation or the absorption of toxic products, and great care is necessary in order to avoid forming an erroneous diagnosis, and mistaking a curable functional disorder for an intractable organic disease.

Paraplegia with decubitus may occur in such conditions as traumatism of the spinal cord, fracture of the vertebræ, pelvic fracture, azoturia, strain of the psoas muscles, parasitic aneurism of the posterior aorta or one of its large branches. In the dog, paraplegia is one of the symptoms of the spinal affection known as 'chronic ossifying pachymeningitis,' and is also observed as one of the sequelæ to distemper.

In many instances there is marked difficulty in determining the cause of an inability to rise. The history of a fall or other injury is very suggestive, and a rectal examination may reveal the presence of a pelvic fracture; but it is not uncommon to find a horse, with a previous history of good health, and without obvious reason, unable to rise in the stall even with assistance. Practical experience in such cases indicates the need for caution in expressing an opinion that a fracture of a vertebra or that a serious spinal lesion is present, as such cases not uncommonly make a rapid recovery.

In paraplegic affections of cattle, such as post-parturient decubitus, it is frequently impossible to determine the origin of the disability, and recourse must be had to expectant treatment.

Symptoms furnished by the Surface of the Body and the Extremities.

The coat of the healthy horse presents a smooth and glossy appearance. In healthy cattle, when the skin is plucked between finger and thumb, it is soft and pliant. In debilitating disease conditions the skin is dry, inelastic, scurfy, and adheres to the

underlying tissues. The terms 'hidebound' and 'out of condition' are used by stock-owners to describe this condition.

Rigors occur in the initial stage of many febrile affections, and are often the first symptom observed by the attendant. Thus, influenza, pneumonia, and lymphangitis may be ushered in with a severe rigor, accompanied by a 'staring coat' and coldness of the extremities.

Profuse Sweating occurs in a number of conditions in the horse. It is seen in the early stages of the condition still named 'azoturia' (really a myoglobinuria), and in acute painful conditions, such as spasmodic colic, volvulus, and laminitis.

Cold sweats distributed over the body, accompanied by a sub-normal temperature, frequently precede a fatal termination in cases of colic.

Œdema of the Limbs is a condition which varies in degree and in importance. Thus, in the horse, slight œdema of the limbs may result from lack of sufficient exercise; on the other hand, it may be due to serious circulatory disorders. It is also met with as a prominent symptom in the effusive type of influenza, and in purpura hæmorrhagica. In this affection the swelling is characteristic, in that it ceases abruptly and gives an appearance such as that produced by a cord applied to the limb at the upper and lower margins of the effusion.

Dropsical Swellings on the dependent parts of the body—*i.e.*, along the sternum, the inferior abdominal region, and in the prepuce or mammæ—may accompany debilitating diseases. If depending upon serious circulatory disturbance, they will be found associated with some degree of hydrothorax and ascites.

In cattle a dropsical swelling in the region of the dewlap, if associated with recurring attacks of tympany of the rumen, suggests the presence of traumatic pericarditis (due to a sharp-pointed body having migrated from the reticulum to the pericardial cavity).

THE CARE, MANAGEMENT, AND NURSING OF SICK ANIMALS

IN former times the practice of medicine largely consisted in the administration of drugs; the natural powers of recovery were not sufficiently appreciated, and when cases terminated favourably the result was too often attributed to the medicinal agents employed. Little attention was devoted to hygiene, dietetics, and careful nursing; and if the patients refused to feed, fluid nutriments and alcoholic stimulants were forcibly administered in the form of draughts. The beneficial effects of pure air were ignored, and the proper ventilation of the stable and byre was neglected. A marked change has now been brought about in the principles of treatment; the forcible administration of draughts of either medicinal agents or fluid nutriments is as far as possible avoided, and we recognize the importance of careful nursing in all species of patients, and also the necessity for adequate ventilation and attention to the general comfort of the animals. Drugs, especially those exerting a drastic action, are now less frequently prescribed, and are more commonly administered in the form of electuary, in the drinking water, by hypodermic injection, or by stomach tube, as the risks attendant upon the administration of draughts are clearly recognized.

The Care and Nursing of Sick Horses.

The horse, when ill, requires careful management and nursing, but, except in adequately equipped and well-managed stables, it is difficult to obtain skilled attendants as nurses.

The housing of the patient under hygienic conditions constitutes a highly important factor in the treatment of disease. Good nursing consists in great measure in attending to the animal's comfort. In the case of horses in stables a loose-box is much preferable to a standing stall. In a loose-box the patient enjoys comparative freedom of movement, a matter the importance of which is generally insufficiently appreciated.

The proper ventilation of the stable should, if possible, be

secured, and in the treatment of respiratory diseases a free supply of fresh air is of paramount importance. Not infrequently, because of lack of accommodation, cases of pneumonia are treated in improperly ventilated stables which are occupied by a number of other horses. In such cases treatment will be much more likely to succeed if the animal be confined in a temporary enclosure in the open. It has been clearly proved that even in the most inclement weather the 'open-air treatment' of acute respiratory affections is much to be preferred to confining the animal in a warm vitiated atmosphere. In forming a temporary open-air enclosure, head covering should, if possible, be made use of (a portion of a cart shed serves admirably for this purpose), and the patient may be suitably clothed.

A clean, dry, straw bed should be provided, and the straw should be properly laid so that the horse's movements may not be hampered.

In cases that are unable to rise a specially thick bed should be provided. A deep layer of straw on peat moss is suitable, and the bed should be frequently remade.

In cases such as those of severe abdominal pain, in which violent symptoms are manifested, means must be adopted to prevent the animal from injuring himself during his convulsive struggles.

Owners of studs should be advised as to the necessity for at least one isolation loose-box in which cases of infectious diseases may be segregated. Too often it is found that where loose-boxes have been constructed they are in direct communication with the stable proper.

Clothing.—Coldness of the surface of the body and extremities, and the presence of rigors, are indications for the employment of extra rugs and the application of woollen bandages to the legs. Clothing properly applied promotes cutaneous circulation, and so tends to overcome the effects of chill. Excessive clothing is oppressive, and causes sweating and fatigue, especially in acute febrile conditions. If the weather be cold, more clothing is required than under opposite conditions, but it should not be too heavy. Care should be taken that the clothing used is dry, that the surcingle is not fastened too tightly, and that the bandages are properly applied and removed twice daily. It is advisable to wrap the limbs in a layer of cotton-wool before applying bandages; this obviates the risk of these being applied too tightly, and so interfering with the circulation.

In country practice suitable bandages and rugs are seldom available, in which case we have to make use of ropes formed of twisted hay in place of woollen bandages, while bed-blankets or quilts may have to be requisitioned instead of rugs. During con-

valescence the extra clothing should be *gradually* removed, to avoid the risk of chill.

Usually animal attendants err in that they apply an excessive amount of clothing. It is not uncommon to find a case of influenza or pneumonia in a farmer's stable so heavily weighted with a miscellaneous collection of blankets and rugs, that profuse sweating and distress are produced; while every aperture in the building through which air might enter is carefully closed. Under such conditions the mortality from these diseases is commonly high.

Diet.—The proper feeding of sick animals constitutes one of the most important factors in good nursing. The appetite for food is in most instances a fair index of progress. When food of every kind is refused for any length of time, the case must be regarded as serious, as total abstinence from food in the horse soon leads to exhaustion. It is necessary to impress upon the attendant the fact that food partaken of voluntarily will be digested and afford nourishment, while the practice of forcing gruels and stimulants on the animal is not only in itself dangerous, but irritates and distresses the patient, causes digestive derangement, and still further decreases the natural appetite for food. A careless or ignorant attendant may complain that the animal under his care will take no food. On inquiring into the matter, it is often found that a quantity of sour food has been left in front of the patient, that the manger and feeding utensils are in a dirty condition, that the proper preparation of the food has been neglected, and that no attempt has been made to vary the diet.

The sick horse is most fastidious in his appetite, and considerable coaxing may be necessary in order to induce him to feed. The thorough cleansing of the manger and feeding utensils is of primary importance. This is a simple matter, but one that is commonly neglected. If the fixed manger be an unsuitable place from which to feed a sick horse—and this is often the case—it is advisable to make use of one or more flat-bottomed basins securely fixed to prevent their upsetting. These are preferable to deep stable buckets, as it is desirable to offer the food in small quantities, and they should be so placed that the animal may be able to feed with the minimum of exertion or discomfort. In respiratory diseases, or in affections accompanied by profuse nasal discharge, it is sometimes desirable that the feeding vessel be placed at a low level, so as to facilitate the escape of discharges from the nasal passages.

The selection of the food is the next consideration. A diet that is easily digested, nourishing, and slightly laxative is usually indicated. Highly nitrogenous food is contra-indicated, especially

in febrile conditions; so, when it is considered advisable to allow oats, only small quantities should be given, preferably prepared by scalding or steaming, as such 'cooking' renders them more digestible. The quality of all foods used should be of a high standard.

The following are useful foods for the sick horse: Bran mash, linseed and bran mash, oatmeal porridge, oatmeal gruel, linseed tea, hay tea, grass in moderation, carrots, mangolds, and boiled Swedish turnips (allowed with discretion), good hay, small quantities of steamed oats, and milk *ad lib.* Directions for the special preparation of foods will be found on pages 46 and 47.

The animal should be fed 'little and often.' Large feeds are either left unfinished and turn sour, or, if eaten, may derange digestion. During convalescence the animal may be eager for food, and if allowed full feeds, digestive disturbance is likely to result. Care in the selection of the diet is especially necessary during convalescence from acute febrile affections. Until the digestive functions have been restored to a normal condition, it is advisable to avoid solid foods, and to allow only a diet of a semi-fluid nature. In cases recovering from such diseases as azoturia and lymphangitis, a highly nitrogenous diet should be avoided.

When the appetite is totally in abeyance, the attendant should be instructed to tempt the animal to feed by offering small amounts of various kinds of food freshly prepared. Discretion is necessary in allowing roots and freshly cut grass to horses unaccustomed to such diet. In small amounts, however, they may be given with safety, and food partaken of voluntarily is likely to prove of benefit to the patient. Small amounts of grass, carrots, a few apples or potatoes, may be offered, so that by easy stages the animal is accustomed to an ordinary diet.

BRAN MASH for sick horses is perhaps the most commonly adopted of all diets. It is of little nutritive value; but it acts as a laxative, and as such is useful. Most horses quickly tire of bran, but careful preparation renders it more palatable.

To prepare a bran mash: Into a clean stable bucket put 3 pounds of best quality bran and 1 ounce of salt, and add 2½ pints of boiling water; stir up well and cover over; allow it to stand for fifteen or twenty minutes, and place before the animal when it is sufficiently cool. The addition of a little treacle to the bran mash is relished by some horses.

BRAN AND LINSEED MASH.—Take 1 pound of linseed and 3 quarts of water and boil slowly for about three hours, so that about 2 quarts of thick liquid remain. Add 2 pounds of bran and 1 ounce of salt, stir thoroughly, cover over, and allow it to stand until sufficiently cool.

LINSEED TEA.—Boil 1 pound of linseed in 2 gallons of water until the grains are soft.

OATMEAL PORRIDGE.—Take 1 pound of oatmeal and put it into a gallon of cold water; bring this to boiling-point, stirring it well; then allow it to simmer over a slow fire until it becomes thick. Some horses will take this readily if mixed with milk and sweetened with a little sugar.

OATMEAL GRUEL.—This is prepared by scalding the oatmeal with boiling water, stirring well to break up any lumps that may form, then adding a little salt and a sufficiency of cold water.

HAY TEA.—Scald a clean stable bucket; pack it with best quality hay, and cover this with boiling water; cover and allow to stand until cold, then strain. This drink is usually relished.

SCALDED OATS in small quantities may be allowed during convalescence, and gradually increased in amount when walking exercise is permissible.

HAY should be fresh and sweet, and allowed in small amounts at a time, not in the large rackful that is so frequently left in front of a sick horse.

MILK is a highly valuable invalid food for the horse. The containing vessel must be kept scrupulously clean, and the milk should always be supplied fresh. Some horses prefer milk diluted with water, while others take it more readily when it is sweetened by the addition of sugar.

We may vary the diet by allowing small amounts of boiled foods, which in small quantities are often relished by sick animals.

Cases are met with in which all efforts fail to persuade the animal to feed, but it is only in very rare instances that the forcible feeding of horses and cattle is justified; in such cases nutrients may be administered by stomach tube. They should never be given in the form of draughts.

Water.—Attendants upon sick horses frequently do not appreciate the necessity for supplying their patients with a plentiful supply of water. It is commonly believed that cold water is capable of causing serious reactions, and it is therefore desirable that the practitioner ascertain that a bucket containing pure cold water is always left within reach of the patient. Water assists in reducing fever, allays thirst, is necessary for digestion and assimilation, and promotes the action of the excretory organs.

Salines can be conveniently administered in the drinking water; but the practice of attempting to give large doses of salines, such as magnesium sulphate, in this manner is to be

avoided, as the obnoxious taste often prevents the patient from taking sufficient fluid.

Grooming.—In acute respiratory affections grooming should not be carried out; it annoys the patient, pollutes the air, and unduly exposes the surface of the body. The clothing ought to be removed once a day and rearranged, the legs and ears hand-rubbed, and the surface of the body gently rubbed over with a soft cloth. The mouth, nostrils, eyes, and forehead, may be lightly sponged with lukewarm water. In cases exhibiting a nasal discharge the nostrils should be frequently cleansed. In cases of strangles the attendant ought to be instructed not to permit any of the discharge to come into contact with the eyes of the animal, as there is risk of a purulent ophthalmia occurring as the result of neglect of this precaution. The feet should be carefully cleaned, and in cases in which the animal stands for long periods the shoes should be removed.

Exercise.—During the course of febrile affections the patient should not be exercised. When the temperature falls to normal and all evidences of acute disease have disappeared, gentle walking exercise will prove of advantage. Such exercise, however, must be only gradually increased, and on no account must the animal be distressed by exertion. During convalescence from acute gastric and intestinal disorders, walking exercise in moderation is beneficial.

Many owners desire that sick horses be returned to work before the practitioner is satisfied that their convalescence is complete. In such cases the practitioner would fail in his duty if he allowed the owner's solicitations to overcome his professional opinion.

Cattle.

Although the sick cow does not respond in the same degree to the intimate attentions of the byreman as does the more intelligent horse to the services of the groom, good sick nursing is of as great importance in the herd as it is in the stud.

In the previous section considerable emphasis has been laid upon the importance of placing the sick horse in an isolated enclosure, sheltered by head cover from rain. That such an enclosure be draughty and cold is of little consequence, provided that the horse be adequately protected by wind cover and warm clothing. These environmental conditions, however, while they may be suitable for the feeding bullock, are not applicable to the milch cow, which must be afforded a much greater degree of equable warmth and protection.

In a dairy herd, the provision of one or more loose-boxes, or

a short range of isolation stalls, is highly desirable, but seldom exists. Such accommodation affords the animal comparative quietude and comfort, and ensures a degree of purity of air unobtainable in the average byre; it also permits of the segregation of cases suffering from contagious disease. These considerations usually outweigh the fact that segregation may have a disturbing effect upon a cow accustomed to the company of her fellows in the herd.

When the patient is decumbent, she must be given particular care and attention. If she be in a double stall, her neighbour should be removed so that she may be afforded greater freedom. She should be given a deep bed of straw, and since ruminants, if allowed to lie prostrate on the side, soon become dangerously tympanitic, the patient should be supported with the aid of sacks filled with straw, or by other similar means, so that she is retained in a more or less natural recumbent position, and care should be taken that she rest upon alternate sides, and that her position be changed every few hours; a string link should be put in the binding chain, or, alternatively, a head collar and rope may be substituted for the chain, so that her head may be readily released in emergency. In decumbent cows the rectum and bladder must, if necessary, be evacuated at proper intervals.

With such minor modifications as are here indicated the principles governing the sick nursing of horses (*q.v.*) are of equal application to cattle.

The Care of Parturient Cows.

Exercise, if not essential to the non-lactating pregnant cow, is always beneficial. Even in winter, parturient cows may be turned out of doors for a short time daily, unless during very stormy or extremely cold weather. In summer they may be continuously pastured, and housed only when it is apparent that parturition is imminent; or they may be allowed to calve in the field, but this course does not permit of the close supervision which is desirable.

Where the accommodation permits, the non-lactating pregnant cows may be removed from the milking herd, and housed separately in loose-boxes until they have calved; but if, as is usually the case, the calf is born in the byre, the drainage channel should be previously filled in with bundles of straw as a precautionary measure against injury to cow and calf.

Parturition is a normal physiological act, and while assistance, when that is necessary, should be immediately rendered, prema-

ture interference on the part of attendants is highly undesirable. The foetal membranes, distended by their contained fluid, play an important rôle, under the impulse of the uterine contractions, in dilating the vagina previous to the passage of the foetus. Dilatation will, therefore, be most satisfactorily effected by waiting until the membranes rupture naturally. Thereafter, the attendants may render assistance in expediting delivery.

The cow's desire to lick her new-born calf is a maternal instinct which should be respected. She should then be given a warm or (if she prefer it) a cold gruel, and the little animal should receive a brisk rubbing with a rough straw wisp. This not only assists in drying the coat, but reflexly induces general circulatory stimulation. Even if the calf is to be hand-reared it should receive colostrum, since this contains readily assimilable proteins, and is rich in minerals, notably sodium, calcium and phosphorus. Colostrum not only exerts a definite laxative action, but, because it also contains the essential vitamin A, it possesses important anti-infective properties.

The placental membranes are usually spontaneously expelled within a few hours, but if they be retained for a period longer than twelve hours, and if they then be still intimately adherent to the maternal cotyledons, no undue force should be applied in attempts to effect their removal. In such cases, antiseptic pessaries (containing iodoform, boracic acid, etc.) should be inserted into the uterus, and the membranes left *in situ*. When this procedure is adopted, the membranes, if they be not spontaneously expelled, can usually be completely removed by gentle traction within twenty-four to forty-eight hours. Expulsion of the placenta results from the contraction of the uterus; it therefore follows that any factor which hinders normal uterine contraction should be avoided. The common practice of irrigating the uterus with antiseptic fluids is therefore contra-indicated, unless the fluid residual to such irrigation can be completely removed by syphonage, since the presence of a considerable volume of fluid in the uterus retards its normal contraction (p. 476).

It is to be realized that retention of the placental membranes may indicate *Br. abortus* infection.

The Dog.

The dog, because of his very high degree of intelligence, his domestication, and his intimate relationships with man, has a psychical development far surpassing that of any other domestic animal. It is probably for this reason that the sick dog is

particularly susceptible to the influences—whether these be good or ill—which are occasioned by his environmental conditions.

In canine practice it is frequently found that cases are more satisfactorily treated at home than in hospital. Many dogs are extremely sensitive, and suffer pronounced mental depression if confined in uncongenial surroundings. The psychological effect of suddenly removing a sick dog from his home and intimate associations, and confining him in a hospital where he is attended, however kindly, by strangers, and where he finds himself in the company of other, and probably hostile, dogs, is not sufficiently appreciated. His mind is possessed by suspicion and fear, and extreme mental depression is frequently evident. It is unnecessary to emphasize the important rôles which such factors play in militating against recovery. These observations are particularly true in the case of dogs suffering from acute respiratory and alimentary affections. On the other hand, there are some dogs which become accustomed to their novel conditions in a very short time, and appear to be quite unaffected by their unusual environment.

The dog, then, is to be regarded as a highly sentient creature, than which no veterinary patient responds more completely to attention and care; but, because of the affection which he is capable of inspiring, he is frequently over-nursed by his owner, in that he is subjected to much handling, petting and blandishment, by which he is harassed and distressed.

If possible, the patient should be nursed in a quiet, well-ventilated room of equable temperature. The bed may be formed of a box or basket raised a few inches above the floor, and the bedding should consist of two or more folds of turkish towelling, which may, if desired, be placed over hay or straw. Such bedding can be daily-changed and renewed, and, in the case of infectious disease, the straw may be burned and the towelling sterilized by boiling.

When it is necessary to maintain bodily warmth, clothing in the form of a light woollen jacket may be applied. Lay attendants frequently err in swathing the animal in heavy shawls or blankets, which occasion considerable discomfort and even acute distress. Indiarubber warm water bottles, which, however, should be covered with flannel, may, if necessary, be placed under the bedding, but care must be observed that their use does not cause discomfort.

The sick dog should, if possible, be given complete rest, and all physical exertion minimized.

Much difficulty is often experienced in persuading well-trained house dogs to void their excreta in the sickroom. This,

however, may be accomplished by the provision of a tray containing moist earth, ashes or sawdust. If necessary, fæces may be evacuated by the use of glycerin suppositories, but, especially in the male, the urine is often retained to a dangerous degree. In such cases the animal should be placed on his feet, and very gentle pressure applied to the abdomen. This usually succeeds, but, should it fail, the dog must be warmly wrapped and carried out of doors. This procedure, although sometimes highly undesirable, is preferable to catheterization.

DIET.—The nursing and management of a sick animal have as their primary object the conservation and maintenance of the patient's strength, so that he shall most effectively bring into action such powers of resistance to disease as he may possess. Since the assimilation of nutriments is vital to tissue change and repair, and because the ravages of disease inflict greater or less tissue damage, it becomes the more desirable that the means whereby such damage can be speedily repaired should be afforded. But disease may itself blunt or destroy the natural appetite for food, so that, on *prima facie* consideration, it would seem that in this instance the natural response of the animal organism to disease has failed to quicken the very instinctive sense which would most usefully serve to combat the attack. Loss of appetite in a sick animal is, however, in many instances, a protective response, and during the first few days of illness anorexia need occasion no particular concern. Nutriments should not be forced upon the animal by spoon feeding. In persistent anorexia, recourse may be had to the intravenous or subcutaneous injection of normal saline containing 5 per cent. of glucose, but it is highly desirable that the appetite be maintained and, if possible, stimulated by offering food in small quantities and in an attractive and palatable form. Food, not infrequently, is accepted from the fingers of the owner when it is refused if offered in a feeding dish.

The character of the sick diet is dependent upon the nature of the affection from which the patient is suffering.

Milk is a standard invalid food because of the completeness of the nutritive elements represented in its composition, and of the facility with which these can be assimilated. In a number of cases of catarrhal gastritis even milk is not retained in the stomach, but it is more readily tolerated if it be diluted with aerated soda water or lime water. Milk foods—*i.e.*, farinaceous substances such as rice, arrowroot and cornflour, prepared as 'milk puddings'—are light and nourishing, and possess distinctly astringent action. Wholemeal bread, on the contrary, is laxative, and for this purpose may be given in beef-tea.

White of egg whipped in milk is usually appreciated, and is

readily assimilated. Raw egg yolk may be incorporated in nutrient enemata.

Well-boiled minced tripe, thymus and pancreas ('sweetbread') provide useful changes to the sick diet. Raw liver is often much relished, especially during convalescence, and is of particular service in constipation, as it possesses a distinctly laxative action. These substances are, however, rich in purins, and are therefore contra-indicated in nephritis.

White fish—*i.e.*, haddock, whiting and cod—boiled in milk or steamed, is less highly nitrogenous than red meat.

Raw beef-steak, freed from fat, finely minced or scraped, and given in very small quantities, is relished, and is usually readily retained even by an irritable stomach. It is especially indicated during the convalescent stages of specific catarrhal fevers—*e.g.*, distemper. Meat extracts are of particular service when the stomach is in a highly irritable condition. They may be given mixed with small quantities of crushed ice, in which form they are usually readily accepted and retained. Cold extract of beef may be prepared by macerating a small quantity of finely minced beef in water. The fluid is strained off at intervals and offered in small quantities. Such delicacies as boiled chicken, rabbit, or calves'-foot jelly are of particular service in stimulating the appetite during convalescence.

THE ACTIONS AND USES OF DRUGS

HALE WHITE adopts the following system in classifying the actions of drugs:

The PRIMARY ACTION is that due to the unaltered drug—*e.g.*, the emetic action of sulphate of zinc.

The SECONDARY ACTION is that due to compounds formed by the drug while it is in the body—*e.g.*, the action of benzoic acid in rendering alkaline urine acid results from the formation in the kidneys of hippuric acid.

The DIRECT or LOCAL ACTION is that produced in any organ with which the drug comes into contact—*e.g.*, cantharidin in passing through the kidneys causes inflammation in them.

The INDIRECT or REMOTE ACTION is a secondary effect, the result of the direct action—*e.g.*, those emetics which act by stimulating the vomiting centre in the medulla also stimulate the respiratory centre which lies in close proximity to it; by so increasing the respiratory movements and by inducing the expiratory efforts which occur in vomiting an expectorant action is elicited.

Some drugs have a selective action in that they possess a predilection for certain tissues. Strychnine is characterized by its powerful stimulant action exerted immediately on the afferent side of the inferior cornual cells. Adrenaline stimulates the myoneural junctions of the sympathetic system. Nicotine paralyzes the sympathetic ganglionic cells.

Circumstances modifying the Action of Drugs.

1. The Mode of Administration.

INTRAVENOUS INJECTION.—Drugs introduced directly into the blood-stream act more rapidly than by any other mode of administration (p. 101).

HYPODERMIC AND INTRAMUSCULAR INJECTIONS (see p. 100).—Drugs injected subcutaneously or intramuscularly are quickly absorbed from the capillaries and lymphatics into the blood-stream.

BY THE MOUTH.—Drugs administered either in the liquid or solid form are absorbed by the vessels of the intestinal mucosa and enter the blood. In the case of a few drugs—*e.g.*, alcohol—absorption can occur through the gastric mucous membrane. The rapidity of absorption depends on the nature of the drug, the form in which it is administered, and the condition of the stomach and intestines. If given in solid form, when the alimentary canal contains a large amount of ingesta, absorption will be comparatively slow and the general effects somewhat uncertain.

Wester has shown that fluids given to cattle by mouth may pass directly to the abomasum, especially if they are acid in reaction or astringent in their effect; but if given by stomach tube the production of the oesophageal reflex is interfered with and the fluid passes into the rumen or reticulum.

BY THE RESPIRATORY TRACT.—(1) By inhalation, absorption in the case of highly volatile drugs is very active and rapid, as is seen in the inhalation of chloroform or ether; (2) intratracheal injections—*i.e.*, the injection of drugs directly into the trachea (see p. 101).

BY THE PERITONEUM.—Drugs administered by intraperitoneal injection are rapidly absorbed (see p. 100).

BY THE SKIN absorption is slow and uncertain. Examples of this mode of action are seen in the effects produced by the application of ointments containing drugs such as mercury, cantharides, and iodoform.

If the epidermis be removed, absorption takes place more actively. In veterinary practice this mode of administration is not employed, and applications to the skin are only intended to produce a local action. When, however, ointments or dressings containing an excessive proportion of mercury are used, or if preparations of proper strength be applied over an extensive area of the skin, toxic symptoms may develop.

BY THE RECTUM.—Solutions of active drugs administered in the form of enemata are comparatively slowly absorbed.

2. The Species of Animals.

Because of anatomical and physiological differences in the horse, ox, and dog, the actions of many medicinal agents on these animals are not uniform.

IN THE HORSE emetics do not induce vomiting for the reason that, apart from certain anatomical peculiarities which inhibit the act of emesis, the vomiting centre is not developed in this animal. Probably because of the large extent and volume of the intestines in the horse, purgatives often act in a very erratic manner. Opium or morphine may fail to exert sedative effects in horses and,

if given in full or repeated doses, may produce nervous excitement and delirium, these actions probably depending on the higher development of the spinal reflex centres as compared with the cerebral centres. Diaphoretics have little or no action on the skin of the horse.

CATTLE.—Medicines administered by mouth to cattle are slow in action, since they must reach the small intestine before absorption occurs, and when forcibly administered by mouth they frequently enter the rumen or reticulum. Further, the volume of ingesta in the rumen tends to interfere with their action, and they may be rendered inert by the process of fermentation.

Dogs are very susceptible to the action of drugs; in these animals the alimentary tract is simple, and when given by mouth drugs quickly exert their effect.

3. The Influence of Age and Size.

Young animals are more susceptible than adults to the action of drugs. In aged animals the vital organs become weakened and impaired, and ordinary doses may act excessively.

Animals of the same species vary in size, and the doses must be regulated accordingly. In canine practice the weight of the patient forms a basis for estimating the dose.

4. The Effect of Disease.

The actions of drugs may be considerably modified by diseased conditions. Thus, in the horse, in cases of impaction of the stomach, dependent upon spasm of the pyloric sphincter, medicinal agents administered by the mouth may elicit no effect, the drugs being unable to reach the small intestine. In impaction of the colon accompanied by stasis of the gut, purgatives such as aloes may fail to act, and it is necessary to have recourse to the hypodermic injection of purgative agents such as physostigmine or arecoline. In acute enteritis large doses of sedatives or anodynes may fail to relieve the pain, even when administered by hypodermic injection. Very large doses of sedatives may produce little or no effect on the convulsions attendant upon acute encephalo-myelitis.

In debilitating affections such as influenza and other acute catarrhal conditions the alimentary canal is very sensitive to the action of purgatives, and a moderate dose of aloes may result in superpurgation.

In many diseased conditions of cattle, the delicate neuromuscular mechanism which controls the stomach movements is deranged, with resultant gastric stasis, so that drugs administered by mouth reach the intestine only after a prolonged interval.

5. The Dose.

The dose has a material effect on the action of a drug. Thus, in small repeated doses, magnesium sulphate is diuretic, while in a full dose it is purgative. The explanation is found in the fact that in small doses salines are absorbed into the blood; there, by increasing osmotic tension, they withdraw water from the tissues, and the resulting increase in the liquor sanguinis is removed by diuresis.

Large doses of salines form hypertonic salt solutions in the bowel, and so absorb water from the tissues, which in this case is removed by purgation.

The *physiological* action of a drug signifies the marked and distinct effect which is elicited by the administration of full doses. This is exemplified by the muscular twitching produced by full doses of strychnine, the gastric irritation and conjunctivitis caused by the continued administration of arsenic, and the phenomena of iodism brought about by repeated full doses of iodine compounds.

In therapeutics we do not usually desire to induce the physiological action of a drug; but there are occasions on which beneficial effects will not be obtained until the administration of the medicinal agent is pushed to its limits—for example, strychnine in certain forms of paralysis, potassium iodide in actinomycosis, and arsenic in trypanosomiasis.

6. Frequency, Toleration, Habit, Accumulation.

FREQUENCY.—When the administration of a drug is repeated at frequent intervals the effect is to continue its action.

TOLERATION AND HABIT.—Certain medicinal agents if administered for a period of time in gradually increasing doses lose their effect, in that the animal acquires tolerance. Arsenic if given in this way may not cause poisonous effects, even when large doses are ultimately reached. Again, animals which receive repeated doses of oleaginous laxatives acquire tolerance, so that after a time medicinal doses lose their aperient effect.

ACCUMULATION.—Certain drugs are said to be *cumulative* in their action—*i.e.*, small doses frequently repeated may show no injurious effects for a time; then suddenly their physiological action is manifested to a marked or even dangerous degree. This phenomenon may depend on absorption being more rapid than excretion, as is the case with strychnine, or it may depend on defective excretion such as occurs when the kidney function is impaired. Cumulative drugs are exemplified by digitalis, mercury, strychnine, iodides, and lead.

7. Idiosyncrasy.

Some individuals possess a peculiar susceptibility, others a resistance, to the action of certain drugs. This is termed 'idiosyncrasy,' and not infrequently it is a source of trouble to the therapist—for example, aloes in medicinal dose may, despite all precautions, induce superpurgation in one horse, while it may fail to act in another. Again, the application of an ordinary blister may occasionally cause marked irritation and constitutional disturbance. Some cattle are highly susceptible to the action of strychnine. Occasionally we find that in the horse one ounce of chloral hydrate will produce stupor and inco-ordination of gait, while in other instances no perceptible effect is produced.

8. The Effect of Climate and Physical Condition.

Narcotics act more quickly in hot than in cold climates. Anæsthetics produce their effects more rapidly in hot than in cold weather; and grass-fed horses are more quickly brought under the influence of chloroform than those that are stable-fed and in hard physical condition. Ill-nourished, overworked horses are more susceptible to the action of drugs than those under opposite conditions.

Horses in Scotland require larger doses of aloes than those in England and Ireland.

9. Synergism.

If two or more drugs having the same effect be combined, the effect produced will be more speedy and will be greater than if an equivalent dose of any one be administered. Thus, if bromide of potassium and chloral hydrate be prescribed together, the narcotic effect will be more pronounced than if either be prescribed alone in correspondingly larger doses.

10. Time.

Some medicinal agents are prescribed to be given before feeding, and others either in the food or after feeding. Alkalies administered before feeding correct excessive gastric secretion. Vegetable bitters, such as calumba and gentian, given to the fasting animal, increase the flow of gastric juice and promote appetite. Acids are prescribed after feeding in cases in which the natural acid of the stomach is deficient. Drugs, such as arsenic, which tend to cause irritation of the gastric mucosa, should be given either with the food or immediately after feeding. In herbivora, iodine, when prescribed, should be given at an interval after feeding, as otherwise an insoluble iodide of starch is produced.

AUTONOMIC NERVOUS SYSTEM.

A number of drugs exert a specific action on the autonomic nervous system, and it is therefore desirable briefly to discuss this important nervous mechanism.

The nerve fibres which compose the conducting mechanism of the CENTRAL NERVOUS SYSTEM fall into two main groups:

(1) *Afferent fibres*, which conduct impulses from all parts of the body to the central nervous system.

(2) *Efferent fibres*, which conduct impulses from the brain and cord to the peripheral parts of the body.

Efferent nerve fibres may be primarily classified as:

(a) Those which innervate voluntary muscle, and are therefore under the governance of the will, and concerned in voluntary movement.

(b) Those which govern the processes of the body over which there is no voluntary control.

The vital processes, such as cardiac contraction, gland secretion, and intestinal movement, are not under the control of the will, and represent a system of self-government or autonomy, and the nervous mechanisms which control such functions form what is known as the autonomic nervous system.

The AUTONOMIC NERVOUS SYSTEM includes two distinct mechanisms:

(1) The PARASYMPATHETIC, composed of:

- | | | |
|-------------------|---|--|
| Cranial Autonomic | { | (a) Fibres issuing from the brain stem in the 3rd, 7th, and 9th cranial nerves, together with all the efferent fibres in the 10th cranial nerve. |
| Sacral Autonomic | { | (b) Fibres issuing from the ventral roots of certain sacral nerves. |

(2) The SYMPATHETIC, which originates in fibres given off from the cord in the ventral roots of the spinal nerves between the cervical and lumbar swellings.

These two systems, the parasympathetic and the sympathetic, are mutually antagonistic, since, in the main, the effects produced by their respective stimulation are opposed; thus, while the parasympathetic is motor to the intestine, the sympathetic inhibits its peristaltic movement; the parasympathetic inhibits the heart's action, the sympathetic accelerates it. It is by this process of counteraction that a condition of 'balance' in the vital functions is largely maintained.

The effects produced by the respective stimulation of the para-

sympathetic and sympathetic systems may be briefly shown in the following table:

AUTONOMIC NERVOUS SYSTEM.

<i>Effect of Stimulation of Parasympathetic.</i>	<i>Organ.</i>	<i>Effect of Stimulation of Sympathetic.</i>
Contract	Pupil.	Dilate.
Inhibit	Heart.	Accelerate.
Secrete (thin and watery)	Salivary glands.	Secrete (thick and glairy).
Motor	Stomach.	Inhibit.
Motor	Intestines.	Inhibit.
Nil	Pyloric sphincter.	Constrict.
Nil	Ileo-cæcal sphincter.	Constrict.
Nil	Anal sphincter.	Constrict.
Contract	Bladder.	Relax.
Constrict	Bronchi.	Relax.
Secrete	Gastro-intestinal and bronchial glands.	—
Nil	Sweat glands.	Secrete.

The condition of balance which is maintained by the counteraction of these two systems may be upset by various factors which elicit a specific effect of stimulation or depression on one or other of the divisions of the autonomic nervous system. These factors include such varied substances as vegetable alkaloids, toxins, and endocrine secretions. Thus:

Arecoline	} Stimulate parasympathetic.
Physostigmine	
Pilocarpine	
Acetylcholine	
Atropine	} Depress parasympathetic.
Hyoscyamine	
Adrenaline	} Stimulate sympathetic.
Tyramine	
Ergotamine	} Stimulates, but later depresses sympathetic (motor fibres).

Certain agents, then, are known to excite one or other of the systems, and in so doing they produce a condition of *relative* depression in the opposite system. Conversely, those agents

which depress one system produce a condition of *relative* activity in the other.

A condition of dominance in the parasympathetic is spoken of as VAGOTONIA, while SYMPATHICOTONIA is used with reference to excessive activity of the sympathetic.

CLASSIFICATION OF DRUGS.

According to their effect on the organs and their functions drugs may be classified as follows:

Drugs acting on the Mouth and Salivary Glands.

Sialagogues increase the secretion of saliva.

They may act (1) DIRECTLY upon the gland cells or their secretory nerves (the parasympathetics 7th and 9th).

Examples.—Pilocarpine, physostigmine, nicotine (stimulates the secretory ganglionic cells).

(2) REFLEXLY, by stimulating the peripheral ends of sensory nerves in (a) the mouth (lingual branch of the 5th nerve and glosso-pharyngeal) or (b) the stomach (vagus).

Examples.—(a) Alcohol, acids, bitters, and aromatics.

(b) Antimony, ipecacuanha.

Antisialics diminish the secretion of saliva.

(1) When salivation depends upon reflex irritation of the buccal mucous membrane, certain substances reduce the irritability of the sensory nerve endings and act as antisialics.

Examples.—Chlorate of potash, borax.

(2) Antisialics also act by depressing or paralyzing the terminations of the parasympathetic (secretory) nerve endings.

Example.—Atropine.

Demulcents are substances of a mucilaginous nature, which have the property of protecting mucous membranes when these are irritated or inflamed.

Examples.—Syrup, honey, gums, linseed-tea.

Drugs acting on the Stomach.

1. AGENTS INFLUENCING THE FLOW OF GASTRIC JUICE.

(a) Stomachics are drugs which increase the flow of gastric juice. Some, such as alcohol, the aromatics (containing a volatile oil), and the bitters (containing a bitter principle), are stomachic

by stimulating the gustatory nerves in the tongue and reflexly increasing the gastric juice and so inducing appetite.

Examples.—Gentian, calumba (bitters); mustard, ginger (aromatics).

(b) Alkaline Stomachics (see Antacids, p. 63).

2. AGENTS INFLUENCING THE NERVES OF THE STOMACH AND GASTRIC CIRCULATION.

(a) **Gastric Stimulants** include agents which, by causing slight irritation of the gastric mucosa, increase its vascularity. All irritant substances would fall under this heading, but since active irritants, even if given in small doses, are unsafe, these are not used medicinally.

The presence of food in the stomach acts mechanically as a gastric stimulant, and the stomachics are prescribed in therapeutics for this purpose.

(b) **Gastric Sedatives or Anti-Emetics** relieve gastric pain and control vomiting.

They include such agents as ice, bismuth, ipecacuanha (in minute doses); these act locally: morphine, which acts centrally.

(c) **Gastric Astringents** are seldom used in therapeutics; they are represented by the drugs to be described as Intestinal Astringents (p. 65), and possess similar actions.

3. AGENTS INFLUENCING THE MOVEMENTS OF THE STOMACH.

(a) **Gastric or Stomachic Tonics.**—These, by increasing the acidity of the chyme, stimulate the movements of the stomach.

Examples.—Dilute mineral acids—viz., hydrochloric, nitric, and nitro-hydrochloric acids.

(b) **Nervo-Muscular Gastric Stimulants.**—These increase the tone of the gastric muscle, and stimulate the movements of the stomach.

Example.—Strychnine.

(c) **Carminatives** assist in the expulsion of gases from the stomach and intestines. These gases usually arise from excessive fermentation of the ingesta, depending on interference with normal digestion.

Carminatives regulate the action of the musculature of the stomach and intestines, and lessen spasm and pain depending on irregular or spasmodic contraction of the walls of these viscera. With the escape of flatus, pain and distress caused by gaseous distension are relieved. In tympanites of the stomach carminatives overcome the constriction of the pyloric sphincter and

so permit the gases to escape. Carminatives may thus be regarded as belonging to the class of drugs termed antispasmodics (see p. 77).

Examples.—Aromatic oils, terebene, alcohol, sweet spirit of nitre, spirit of chloroform.

(d) **Emetics.**—Emetics are agents which produce vomiting. The normal horse does not possess the power of vomiting, and emetics are not therefore administered to this animal. While true vomiting does occur in ruminants, it seldom can be induced by drugs, and emetics are never prescribed for cattle and sheep. Vomiting may be readily induced in the dog. Emetics are of two classes:

1. **LOCAL EMETICS** act by irritation of the sensory nerve endings, chiefly the vagus in the stomach, vomiting being produced by a reflex stimulation of the vomiting centre in the medulla. The vomiting centre is capable of receiving impulses arising in the alimentary tract, the liver, heart, lungs, kidney, peritoneum, and uterus, and irritation of any of these organs may produce reflex emesis. Local emetics may fail in action in cases of poisoning by drugs which anæsthetize the gastric mucous membrane—*e.g.*, carbolic acid.

Examples.—Sulphate of zinc, common salt, mustard.

2. **CENTRAL EMETICS** produce emesis by directly stimulating the vomiting centre.

Example.—Apomorphine.

Emetics stimulate the respiratory centre, promote expectoration in the early stages of bronchitis, and, by the expiratory efforts produced, tend to clear the bronchial tubes of the catarrhal products interfering with respiration.

Central emetics are employed to overcome engorgement of the stomach in the dog, and to cause expulsion of foreign bodies from the cervical portion of the œsophagus.

Central emetics may fail to act in narcotic poisoning because of the depression of the medulla.

4. AGENTS INFLUENCING THE CONDITION OF THE GASTRIC CONTENTS.

(a) **Antacids** correct excessive acidity of the ingesta.

Examples.—Alkalies, such as calcined magnesia and lime-water. The bicarbonates of sodium and potassium are effective alkaline stomachics, but, because of the liberation of carbon dioxide and the consequent stimulation of acid production in the stomach, they are considered undesirable as antacids.

(b) **Digestive Adjuvants** are agents which compensate defec-

tive gastric secretion for which they are given as substitutes; thus, hydrochloric acid is given after feeding when there is reason to believe that the amount of that acid secreted is deficient. Pepsin is also administered when there is evidence of defective peptic secretion, but our efforts should rather be directed to the removal of the cause of such deficiencies.

(c) **Gastric Antiseptics** are used in cattle practice to control excessive fermentation in the rumen and in acute gastric tympanites in the horse (see *Intestinal Antiseptics*, p. 65).

The term 'antizymotic' also refers to agents which control excessive fermentation.

Examples.—Formalin, carbolic acid, oil of turpentine.

Drugs acting on the Intestines.

Purgatives or Cathartics cause evacuation of the intestinal contents. The passage of ingesta through the gut may be accelerated by: (1) increasing the volume of non-absorbable matter; (2) by irritating the intestinal mucosa and thus reflexly increasing peristalsis; (3) by direct stimulation of the neuro-muscular mechanism.

(1) **Saline purgatives** act by increasing the amount of fluid in the alimentary canal; the resultant distension of the bowel elicits a moderately increased peristaltic movement. Saline purgatives are not absorbed by the tissues, and their action is based on a physical principle. It is now accepted that the increased amount of fluid is derived from an increased osmotic tension of the bowel contents, a hypertonic saline solution being formed in the bowel, and so withdrawing water from the blood and tissues through the medium of the intestinal wall. Because of the presence of a hypertonic or isotonic saline solution in the intestine absorption is prevented. The purgative effect of saline agents is in inverse proportion to the rapidity of the absorption. The magnesium ion is slowly absorbed, and magnesium sulphate therefore exerts marked osmotic effects.

Examples of laxative agents for the dog which act by increasing the amount of non-absorbable water in the gut are agar-agar and liquid paraffin; the action of the latter is partly due to its softening and lubricating the faecal mass.

(2) **Purgatives** which act by inducing irritation of the intestinal mucosa either (a) contain in themselves irritant principles—*e.g.*, aloes, croton-oil, jalap; or (b) produce irritant substances when they enter the intestine—*e.g.*, the bland castor-oil is hydrolyzed in the small bowel and there sets free the irritant ricinoleic acid; sulphur is inert, but in the colon is transformed into

the mildly irritant sulphuretted hydrogen. Calomel is insoluble, but is transformed into a soluble irritant form in the small intestine.

(3) Purgatives which directly stimulate the neuro-muscular mechanism are represented by arecoline, physostigmine, and pilocarpine. These are parasympathetic excitants exerting their action on the vagal nerve endings (see p. 60).

According to the degree of severity of their action in medicinal doses purgatives may be classified as laxatives (*cascara sagrada*, liquid paraffin), simple purgatives (castor-oil, aloes), and drastics or hydragogue cathartics (gamboge, croton-oil, and barium chloride).

CHOLAGOGUE PURGATIVES.—See p. 66.

USES OF PURGATIVES.—(a) To expel retained fæces.

(b) To act as indirect cholagogues by causing contraction of gall-bladder and/or bile-ducts.

(c) To remove toxic products from the tissues.

(d) To remove fluid from the tissues.

Drastic purgatives were at one time commonly employed in veterinary practice, but it is now recognized that there are very few indications for their use. Only the mildest purgative capable of producing the required effect should be given.

Intestinal Astringents are agents which limit the action of the bowels and correct excessive fluidity of the intestinal contents. Some act as vascular astringents by contracting the intestinal bloodvessels and lessening the amount of fluid excreted.

Examples.—Dilute sulphuric acid and lead salts.

Others lessen peristaltic movements of the intestine.

Examples.—Opium, belladonna in full doses.

Antacids, such as prepared chalk, check excessive action of the intestines by diminishing the acidity of the ingesta.

Bismuth, by covering the intestinal mucous membrane with a protective film, reduces its irritability.

Catechu and substances containing tannin coagulate proteins and so furnish the gut mucosa with a protective covering.

Intestinal astringents are chiefly used in the treatment of diarrhoea, superpurgation, and dysentery.

Intestinal Antiseptics.—These agents diminish the activity of bacteria in the intestine. They are sometimes prescribed in diarrhoea, dysentery, and allied conditions believed to depend on the presence of pathogenic bacteria.

In man the contents of the stomach and the upper two-thirds of the small intestine are practically sterile under normal con-

ditions; the number of living bacteria rapidly increases in the last third of the small intestine and reaches a maximum in the cæcum and anterior portion of the colon, but as the fluid diminishes in the colon so the number of living bacteria decreases. In normal dogs it is probable that the fæces contain comparatively few living bacteria, but in diarrhoea, because of their increased fluidity, the fæces contain enormous numbers.

The problem of intestinal disinfection is one of great difficulty; the drug employed must not be readily soluble, as then it will be absorbed, but it must be soluble to some extent, so that it may mix with the contents of the large bowel. It must neither be irritant nor actively poisonous. It must be such that its action is not markedly diminished by the presence of excess organic matter, nor destroyed by the intestinal ferments. It must act in an alkaline medium.

These conditions are difficult to fulfil, and many of the agents commonly regarded as intestinal disinfectants are probably useless and may even be harmful.

Oil of turpentine, terebene, oil of eucalyptus, carbolic acid, cyllin, naphthalene, creosote, salol, and calomel, are examples of intestinal antiseptics commonly employed.

Intestinal Antizymotics arrest or control intestinal fermentation.

Example.—Formalin.

Agents employed to Destroy and Eradicate Worm Parasites.

Anthelmintics are employed for the eradication of helminth parasites. They include *vermicides*, which kill the parasites, and *vermifuges*, which expel them. Vermifuges are usually purgative in their action.

Examples.—Oil of male fern, carbon tetrachloride, oil of chenopodium, oil of turpentine, santonin, areca-nut.

Drugs acting on the Liver.

Cholagogues increase the secretion of bile. Formerly many purgative agents were believed to be cholagogues, as following their administration an increased amount of bile occurred in the fæces; such drugs were therefore termed 'cholagogue cathartics,' and were represented by calomel and saline purgatives. It is now believed that such agents, by increasing intestinal action, reduce absorption of the bile and reflexly stimulate contraction of the gall bladder and bile ducts; they are therefore spoken

of as 'indirect cholagogues.' Although a very limited number of substances are still referred to as 'direct' cholagogues, it is generally accepted that only bile itself (*Fel Bovinum*) possesses a direct cholagogue action.

Cholagogues are frequently prescribed in a routine manner in hepatic disorders, especially those associated with *icturus*.

The presence of bile in the intestine is considered to be essential for the full action of purgatives such as jalap, the active resin of which is hydrolyzed by the bile; but the addition of glycerin or soap subserves the action of bile in this respect.

Drugs acting on the Urinary Organs.

I. ON THE KIDNEYS.

Diuretics increase the flow of urine. Cold, by checking the secretion of the skin, acts as a diuretic. The ingestion of large amounts of water increases the secretion of urine. Subcutaneous or intravenous injections of full amounts of normal saline solution cause diuresis.

Three classes of diuretics are recognized:

1. **SALINES:** These, after absorption, increase the fluidity of the blood by raising the osmotic tension of the plasma, thus attracting water from the tissue fluids. This increases the blood volume, the excess of fluid is filtered by the glomeruli, and the reabsorption from the tubule is prevented by the presence of the saline.

Example.—Nitrate of potassium.

2. **AGENTS WHICH ACT (a) BY CAUSING DILATATION OF THE RENAL VESSELS WITHOUT MARKEDLY LOWERING THE GENERAL BLOOD-PRESSURE; or (b) BY INCREASING THE PERMEABILITY OF THE RENAL EPITHELIUM.**

Examples.—Sweet spirit of nitre, oil of turpentine, caffeine.

It is now regarded as doubtful whether any diuretics exert their effect by a specific action on the renal epithelium.

The essential oils act as diuretics during their excretion from the body by the kidneys.

3. **AGENTS WHICH ACT AS DIURETICS BY RAISING THE GENERAL BLOOD-PRESSURE AS THE RESULT OF AN INCREASED CARDIAC ACTION.** These are known as cardio-vascular diuretics.

Example.—Digitalis.

The diuretic action of digitalis is specially well marked when the drug is administered in certain conditions of cardiac valvular disease (especially disease of the mitral valve) associated with ascites and venous congestion, so that only a small amount of

urine is passed daily. The administration of digitalis in these conditions results in a free secretion of urine, which depends on the drug's improving the circulation, so that the venous congestion is gradually overcome and a normal flow of arterial blood through the kidneys is re-established.

USES OF DIURETICS.—In certain renal diseases there are occasions on which it is desirable to increase the flow of urine when the functions of the kidneys are impaired. In such cases diuretics hasten the expulsion of waste products from the tissues, and by increasing the proportion of water they flush out the kidneys, especially when diluents are allowed freely. In acute inflammation of the kidneys, irritating diuretics, such as oil of turpentine, are contra-indicated. In febrile disorders diuretics assist in removing the products of tissue waste. In pleural effusion, hydrothorax, and ascites, diuretics may markedly reduce the extent of the effusions. When ascites is associated with cardiac disease, digitalis proves useful by its action in overcoming venous congestion, and also by inducing diuresis.

2. ON THE BLADDER.

Vesical Sedatives relieve irritability of the bladder. They are represented by alkalies, such as bicarbonate of soda; also by hyoscyamus, belladonna, demulcent fluids (barley-water or linseed-tea), and by urinary antiseptics, such as hexamine. Vesical sedatives are prescribed in cystitis and in vesical irritability.

3. AGENTS EXERTING A MODIFYING ACTION ON THE URINE.

(a) **Those modifying the Reaction of the Urine.**—The phosphates of the urine act as buffer salts in that they combine with acids so that considerable quantities of acids may be excreted in the urine without its becoming markedly acid in reaction. In the horse the reaction of the urine in health is alkaline, and is seldom rendered acid by disease. In the dog the reaction is acid, and excessive acidity of the urine occurs in certain diseased conditions. This is overcome by the administration of alkalies, such as bicarbonate of soda or bicarbonate of potash, and also by acetates, citrates, or tartrates of potassium or sodium. The organic salts, such as acetates, produce this effect by being oxidized in the body and excreted as carbonates.

When it is desired to render the urine acid, as during the administration of hexamine, this may be achieved by giving the acid sodium phosphate, benzoic acid (excreted as hippuric acid), or ammonium chloride.

(b) **Those preventing the Deposit of Solids from the Urine or promoting their Removal (Lithontriptics).**—These deposits may occur in the form of sediment, gravel, or as a calculus. The commonest seat is in the bladder (vesical lithiasis), but they may also be found in the kidney or the urethra. In the horse they are composed chiefly of salts of calcium and magnesium. In vesical lithiasis medicinal agents do not produce any beneficial effect, and surgical measures must be employed in operable cases.

In the prevention of such conditions a sufficient supply of pure drinking water should be allowed.

In the dog, deposits of uric acid and acid urates sometimes occur in the bladder or urinary passages. Lithium carbonate is prescribed as a preventive of such conditions; it forms a soluble salt with uric acid, but its therapeutic value is doubtful.

Urinary Antiseptics.—These agents prevent the multiplication of organisms in the urine and on the mucosa of the bladder and urinary passages. In cystitis associated with alkaline decomposition of the urine, the following drugs are prescribed: Benzoic acid, hexamine, salicylic acid, and mandelic acid. All urinary antiseptics act more efficiently in an acid urine, and hexamine has little or no antiseptic action unless the urine be first rendered acid by administering acid sodium phosphate (sodium dihydrogen phosphate). The rate of increase of the pyogenic cocci and putrefactive organisms which in acute cystitis render the urine alkaline is retarded when the urine is rendered acid. In chronic inflammatory conditions of the bladder and urinary passages, agents such as copaiba, cubebs, oil of juniper, terebene, and buchu, are prescribed. These drugs are excreted mainly by the kidneys in combination with glycuronic acid, and during their passage through the bladder and urethra they exert an antiseptic action on the urogenital mucosa and on the urine.

According to Jordan they possess a selective disinfectant action on staphylococci, but have a feeble action in inhibiting putrefaction of the urine.

Drugs acting on the Generative Organs.

Aphrodisiacs increase sexual desire by improving general bodily vigour. Some, such as strychnine, stimulate the spinal sexual centres. Yohimbine appears to exert its action by causing a vascular congestion of the genital erectile tissue. Cantharidin acts as an aphrodisiac by causing reflex irritation of the urogenital mucosa, but is not employed therapeutically for this purpose.

Anaphrodisiacs diminish sexual desire—*e.g.*, general sedatives such as bromide of potassium. Purgatives, a low diet, increased work, also produce this effect.

Ecbolics or Oxytocics stimulate uterine contractions during or immediately after parturition. The most important are ergot and pituitrin (a preparation of the secretion of the posterior lobe of the pituitary gland). Pituitrin is now largely employed in parturition in the bitch when uterine inertia is present. Ergot, or its most active alkaloid ergometrine, given by intramuscular injection, is also employed in similar conditions. Post partum hæmorrhage may be arrested by drugs which cause contraction of the flaccid uterus. Hot water (110° to 120° F.) injected into the uterus also stimulates contraction and assists in checking hæmorrhage. Ergot in combination with stimulants is often prescribed in retention of the placenta, but its efficacy for this purpose is open to doubt. Powdered ergot is notoriously uncertain in its action, and only standardized preparations of the drug or the actual alkaloids can be relied on.

Drugs acting on the Mammary Glands.

Galactagogues.—This term is applied to agents which are believed to increase the secretion of milk, but there are no drugs which are of practical value in this respect. Jaborandi increases the secretion of milk, but only temporarily, and is not employed as a galactagogue. A healthy condition of the dam and generous feeding are necessary for the proper production of milk, and a liberal milk diet assists lactation in animals nursing their young.

Many drugs are partly eliminated by the active mammary gland, and impart to the milk either their flavour or their medicinal properties; these are exemplified by aloes, essential oils, and iodides.

Agents which Check or Diminish the Secretion of Milk—Antigalactagogues.—It has been believed for many years that belladonna diminishes the secretion of milk, whether given internally or applied to the mammary gland. This drug paralyzes the terminations of all nerves supplying secretory glands, but since the mammary glands do not possess secretory fibres, it is highly doubtful whether belladonna has any antigalactagogue action. When it is desirable to hasten the completion of the period of lactation in cows, the most effectual measures consist in administering a purgative, in allowing dry food, and in gradually lengthening the periods between milking.

Drugs acting on the Circulation.

I. ON THE HEART.

Medicinal agents influence the beat of the heart either by altering its rate or by modifying the force of cardiac contraction.

AGENTS WHICH INFLUENCE THE RATE OF CONTRACTION OF THE HEART.

The heart-beat may be slowed by—

(a) AGENTS WHICH STIMULATE THE VAGUS, either by exciting the nerve at its centre in the medulla, or through its endings in the cardiac muscle. Strychnine, and the sudden inhalation of a large amount of concentrated chloroform vapour, cause direct stimulation of the vagus centre in the medulla. Digitalis slows the heart partly by stimulating the peripheral ends of the vagus in the cardiac muscle.

(b) AGENTS WHICH DEPRESS THE ACCELERATOR (SYMPATHETIC) MECHANISM. Of these little is known.

(c) AGENTS WHICH INCREASE BLOOD-PRESSURE.

Examples : Adrenaline, pituitrin.

The heart-beat may be accelerated by—

(a) AGENTS WHICH STIMULATE THE SYMPATHETIC ACCELERATOR MECHANISM. These frequently increase the force as well as the rate of the heart. *Example :* Ammonia.

(b) AGENTS WHICH DEPRESS THE INHIBITORY MECHANISM, by acting either centrally on the medulla and cord (chloroform), or peripherally on the nerve ganglia in the heart (nicotine), or on the nerve endings (atropine).

(c) AGENTS ACTING ON THE CARDIAC MUSCLE can also produce acceleration of the heart-beat by stimulating the excito-motor area in the heart; these at first cause the heart-beat to be slowed, but if given in toxic doses the action of the heart becomes quickened to such an extent that the beats become rapid and incomplete, and the condition known as 'delirium cordis' is produced. *Example :* Caffeine.

(d) AGENTS WHICH LOWER BLOOD-PRESSURE. *Example :* Amyl nitrite.

AGENTS MODIFYING THE FORCE OF CONTRACTION OF THE HEART.

The force of contraction is increased and the heart-beat strengthened by agents which stimulate the cardiac muscle. The force of the heart-beat may be modified by altering the

peripheral resistance in the arterioles (see p. 73). Drugs which depress the cardiac muscle, such as full amounts of chloral hydrate and chloroform (deep anaesthesia), diminish the force of contraction, and thus act as cardiac depressants.

Cardiac Stimulants are employed where there is a tendency to failure of the heart's action, as may occur in cases of influenza, pneumonia, and acute pulmonary congestion. They cause a more forcible heart-beat, and if the pulse be quick, irregular, or weak, it is rendered slower, more regular, and stronger, while blood-pressure is raised. A rise in blood-pressure may be the cause as well as the effect of cardiac stimulation, so it may be said that cardiac stimulants usually elicit their effects either by direct action on the heart muscle or indirectly by vaso-constriction and raising blood-pressure. *Examples:* Strychnine, caffeine, digitalis.

Alcohol was at one time a favourite cardiac stimulant, but is now seldom employed. Alcohol in moderate doses exerts a definite stimulant action on the heart, causing a greater force of contraction, but this action is inferior to that of digitalis. Slight acceleration of the heart's action is produced, partly due to a reflex stimulation by irritation of the stomach and partly to the fact that alcohol affords an easily assimilable source of energy. It does not directly stimulate the cardiac muscle. The superficial vessels become dilated, but the internal vessels are constricted. If large doses of alcohol be given, general dilatation of the vessels of the body occurs. In moderate doses alcohol raises blood-pressure, this being due to vaso-constriction both central and peripheral in origin, and to the increased cardiac output. Strychnine in small doses to some extent increases the strength of the cardiac beats, and this effect is partly due to a direct action on the cardiac muscle. The improvement in the pulse produced by this drug in cases of threatened cardiac failure is to be attributed to increased blood-pressure depending on vaso-constriction due to stimulation of the medulla. The vaso-constriction is believed to be partly peripheral in origin. Caffeine increases the rate of the heart, and to a lesser extent the force of contraction, and also raises blood-pressure.

Cardiac Tonics.—The term is applied to cardiac stimulants, the action of which is sustained—*e.g.*, digitalis, strophanthus, and squill.

The uses of cardiac tonics may be illustrated by considering the indications for treatment in a case of incompetency of the mitral valve. Here, in consequence of the imperfect closure of the mitral valve, a portion of the blood regurgitates through it when the left ventricle contracts, and enters the left auricle.

The pulmonary circulation becomes impeded, and the right side of the heart suffers from distension, general venous congestion resulting. In the early stages a compensatory hypertrophy of the left ventricle occurs, and while this continues the circulation is maintained and no symptoms are manifested. But when compensation fails, circulatory disturbances take place, the cardiac wall becomes weakened, and dilatation of the ventricle occurs; the cardiac action is rapid, but is ineffectual in emptying the cavities of the heart completely. It is when compensation commences to fail that a cardiac tonic is indicated, and digitalis produces beneficial effects by increasing the force of contraction and improving the tone of the cardiac muscle. Digitalis, by stimulating the vagus, also increases the period of diastole, and renders the systole more vigorous and prolonged, the action of the heart at the same time becoming slower and more regular.

Strychnine in small doses is also employed as a cardiac tonic in certain conditions of cardiac disease.

Cardiac Depressants or Cardiac Sedatives diminish the force of cardiac contraction and lessen the frequency of the heart's action. They are represented by aconite, and by large doses of chloral hydrate and narcotic agents. Cardiac sedatives are indicated in cases manifesting a quick, full pulse, as in acute laryngitis, and aconite in small doses, frequently repeated, was at one time commonly employed in the treatment of this condition.

2. ON THE BLOODVESSELS.

The blood-pressure can be modified in various ways. It can be reduced by venesection; by cardiac depressants, such as aconite; and by diminishing the resistance in the peripheral circulation by vaso-dilators, such as amyl nitrite; also by purgatives and rest.

The blood-pressure can be raised by perfusion of normal saline solution into a vein, or by injecting this agent in large quantities subcutaneously or *per rectum*; also by cardiac tonics, and by agents which induce vaso-constriction (strychnine, adrenaline).

Vaso-Constrictors cause contraction of the walls of bloodvessels, thus reducing their calibre. The small arterioles are especially affected by such agents. Strychnine, caffeine, and preparations of ammonia, produce this effect by stimulating the vasomotor centre in the medulla; digitalis causes vaso-constriction by acting directly on the muscular coat in the walls of the bloodvessels. Adrenaline constricts the vessels by stimulating the sympathetic neuro-muscular mechanism, but all vessels are not similarly

affected by adrenaline; thus, while the splanchnic vessels are capable of marked constriction, the vessels of the heart and brain are unaffected.

The hypodermic injection of adrenaline causes local vaso-constriction, and is employed in combination with local anæsthetics. It prevents hæmorrhage and limits the absorption of the anæsthetic. Local vaso-constriction may be obtained by the application of ice or refrigerant lotions to a circumscribed area of the skin.

Vaso-Dilators.—These cause dilatation of the peripheral arterioles. They are represented by chloral hydrate and narcotics, which act by causing depression of the vasomotor centre; also by nitrites, which produce relaxation of the unstriated muscle of the arterioles.

Agents acting as vaso-dilators are used in cases associated with congestion of the internal bloodvessels with the object of bringing about a more even distribution of the blood throughout the body. By dilating surface vessels they allow of a more rapid radiation of heat, and so act as febrifuges.

Drugs acting on the Respiratory Organs.

Expectorants cause either an increase of bronchial secretion or render such secretion more fluid, and thus facilitate its expulsion.

In the horse, expectoration does not occur in the same sense as in the human subject. The expectorate reaches the pharynx from the air-passages as the result of coughing, and may be swallowed, or a portion may be discharged by the nostrils. In the dog the expectorate, when coughed up, reaches the pharynx and is swallowed.

The vagus is the secretory nerve to the bronchial mucous glands, and expectorants may act *directly* by stimulating the vagal nerve endings in the bronchial mucosa or *reflexly* by stimulating the sensory endings of the vagus in the stomach.

Thus many drugs which are excreted by the bronchial mucosa act as irritants during their excretion and so stimulate secretion. These are represented by potassium iodide (liberates iodine during excretion), camphor, and the volatile oils.

Drugs acting as reflex expectorants are represented by the local emetics (given in small doses)—*e.g.*, squill, ipecacuanha, antimony.

Anti-expectorants.—Drugs which effect decreased expectoration act by depressing the vagus—*e.g.*, belladonna—or by exerting a sedative effect on the bronchial mucosa—*e.g.*, inhalations of warm water vapour, which may be medicated with

creosote, etc. The sedative effect may be partly due to their antiseptic action.

Respiratory Stimulants increase the irritability of the respiratory centre, and augment the depth and the number of the respirations. These are represented by strychnine, ammonia, atropine, lobeline, and caffeine. The sudden application of cold water to the surface of the body reflexly causes deep inspiratory efforts. The inhalation of the vapour of ammonia causes excitation of the sensory nerve-endings (fifth cranial nerve) in the nasal passages, and reflexly induces increased depth of respiration.

Strychnine administered by hypodermic injection is sometimes prescribed in respiratory affections with a view to overcoming depression of the respiratory centre, but its beneficial effects probably result from its action on the circulation. It is also employed as a respiratory stimulant in cases of chloroform anæsthesia when evidences of respiratory failure present themselves, but its value is doubtful.

The respiratory centre may be effectively stimulated reflexly by inducing peripheral irritation by the subcutaneous injection of ether and of camphor in oil.

Respiratory Sedatives lessen the irritability of the respiratory centre. They include agents such as morphine, heroine, and codeine, and are employed in cases in which an irritable persistent cough is a prominent symptom.

Their action in this respect is believed to depend upon the close proximity of the respiratory centre to the centre for the reflex act of coughing.

AGENTS ACTING ON THE BRONCHIAL MUSCULAR TISSUE.

The bronchial muscle receives motor fibres from the vagus and inhibitory fibres from the sympathetic.

Barium chloride and veratrine cause direct constriction of the bronchial muscular tissue. Physostigmine and pilocarpine produce a similar effect by exciting the terminations of the vagi. Veratrine is sometimes employed in the treatment of pulmonary emphysema ('broken wind'), and is combined with strychnine; the combination is said to assist in restoring muscular tone to the alveolar walls and the bronchioles. These drugs prove useful in mild cases, but cannot be expected to exert beneficial effects when pulmonary emphysema is extensive.

Certain drugs have the power of relieving the spasm of the bronchioles in bronchial asthma. Amyl nitrite produces this effect by directly depressing the bronchial muscular tissue.

Belladonna, stramonium, and hyoscyamus act in this manner by depressing the pulmonary terminations of the vagi.

Adrenaline, by stimulating the sympathetic nerve-endings, relaxes the bronchi; this effect is not well marked in the dog.

Drugs acting on the Nervous System.

Cerebral Stimulants.—These are represented by caffeine, cocaine, and atropine. The inhalation of ammonia vapour stimulates the nasal branches of the fifth nerve, and causes reflex stimulation of the vasomotor centre. The general blood-pressure is increased, and the brain is stimulated by the improvement in the cerebral circulation. This effect is also produced by other drugs which act as circulatory stimulants.

Cerebral Sedatives lessen the functional activity of the brain. They include chloral hydrate, bromides, barbiturates, cannabis indica. Morphine in full doses acts as a cerebral excitant in the horse and in the cat, but in the dog it is a cerebral sedative.

Hypnotics or Soporifics are agents which induce sleep. They belong to the group of cerebral sedatives. In the horse, owing probably to the relative lack of development of the cerebrum, hypnotics act in an uncertain manner.

Chloral hydrate, which is a powerful central nervous depressant, is probably the most reliable hypnotic for the horse. In the dog, morphine, bromides, chloralose, chloritone, are efficient hypnotics. Hypnotics are indicated when sleep and rest are interfered with by pain or nervous irritability.

Narcotics include a large number of hypnotics which not only produce sleep, but cause marked depression of the circulatory and respiratory mechanisms. They are represented by morphine, chloral hydrate, barbiturates, cannabis indica (all in large doses).

Anodynes or Analgesics are agents employed for the relief of pain. Many of them belong to the group of hypnotics. In seeking to relieve pain we must endeavour to ascertain its cause.

In the horse, pain arising from various acute disorders of the stomach and intestines ('abdominal pain') is the type most frequently met with. In prescribing measures for its relief, in cases depending on the presence of irritating ingesta in the intestines, or on gastric or intestinal tympany, care should be taken not to administer agents such as opiates, as such drugs inhibit peristaltic movements of the viscera, and thus exaggerate the primary condition. Perhaps the most efficient and least harmful anodyne for the horse is chloral hydrate.

In the dog, morphine acts as a safe and effectual anodyne. For the various forms of painful rheumatic affections in this animal, the salicylates prove of value.

When pain depends on local conditions, local anodynes are employed. The application of heat and moisture, in the form of fomentation or as a cataplasm composed of kaolin and glycerin, is frequently employed.

Antispasmodics relieve or overcome muscular spasms, whether general or local. Spasms occur in tetanus, epilepsy, and strychnine-poisoning, and may be controlled by bromides and chloral hydrate. The spasms of tetany dependent upon acute calcium deficiency rapidly yield to the intravenous or subcutaneous injection of assimilable calcium salts. Spasm of the muscular coat of the colon occurs in 'spasmodic colic' in the horse, and frequently depends on the presence of irritating ingesta. Many such cases are relieved by a dose of oil of turpentine or terebene given in linseed-oil. See also **CARMINATIVES** (p. 62).

Anæsthetics.—Anæsthetics are employed to produce a condition of insensibility to pain during the performance of surgical and obstetrical operations. Anæsthetics are classified as general and local.

GENERAL ANÆSTHETICS are represented by chloroform and ether administered by inhalation. Chloroform is the anæsthetic usually adopted for the horse. Ether produces a prolonged period of excitement in this animal, and is uncertain in its action. For details of the employment of chloroform in the horse the reader is referred to page 191.

Ether is regarded as safer than chloroform for the dog. Full doses of morphine are often employed as an anæsthetic in canine surgery.

Soluble barbiturates are now used intravenously as general anæsthetics in the pig, sheep, dog, and cat.

Chloral hydrate is largely used as an anæsthetic for the horse by Continental practitioners, being administered either by the mouth, by intravenous injection, or as an enema.

LOCAL ANÆSTHETICS are agents which, if injected subcutaneously or into the deeper tissues, produce local loss of sensibility by causing paralysis of the peripheral endings of sensory nerves. Strong solutions painted on mucous membranes exert a similar action. Local anæsthetics are represented by cocaine, novocaine, and stovaine. They are largely employed in minor surgical operations, and by careful infiltration of the deep tissues it is possible to perform even major operations with the avoidance of pain. The combination of adrenaline with a local anæsthetic limits its absorption by the surrounding tissues.

That the part is rendered anæmic is in itself an advantage in that it facilitates surgical procedure.

Local anæsthetics should be injected as close as possible to the nerves supplying the part which it is desired to anæsthetize (see p. 243).

EPIDURAL (SPINAL) ANÆSTHESIA.—The epidural injection of solutions of drugs such as novocaine produces anæsthesia of the posterior part of the body.

Spinal Stimulants.—These include strychnine, caffeine, and ammonia. In medicinal doses they increase conductivity and heighten reflex excitability, but in large doses clonic convulsions are produced.

Spinal stimulants are indicated in certain forms of paralysis.

Spinal Depressants.—Narcotics, hypnotics, and anæsthetics depress the medulla and spinal cord as well as the cerebrum.

Spinal depressants are indicated in cases in which increased excitability of the spinal cord is present, such as tetanus and chorea. For this purpose chloral hydrate, bromides, barbiturates, and cannabis indica are sometimes prescribed.

Drugs which act on nerves may produce their effects by acting on the nerve-centres, the nerve-trunks, or the nerve-endings in muscles, glands, or on the surface of the skin. The nerve-endings are more susceptible to the action of drugs than the nerve-trunks, the latter only being affected when strong solutions of medicinal agents are directly applied to them.

Motor Nerves.—Several drugs, including physostigmine, increase the excitability of motor nerve-endings and produce spasmodic twitching in the voluntary muscles. They have no therapeutic application.

Curare causes paralysis of the motor nerve-endings, and conine acts in a similar manner. The nerve-endings in secretory glands and unstriated muscle are excited by pilocarpine and physostigmine, while atropine and hyoscyamine have the opposite effect—*i.e.*, they paralyze the secretory nerve-endings.

Sensory Nerves.—Aconite, atropine, and carbolic acid diminish the excitability of sensory nerves. Cocaine and allied agents temporarily paralyze the terminations of cutaneous nerves, and also the sensory nerve-trunks when injected locally, and thus are local anæsthetics (see p. 77). Ether spray, cold in the form of ice or freezing mixtures, also reduce the sensibility of sensory nerves in the area to which they are applied. Topical irritants increase the excitability of sensory nerves.

Sympathetic Nerve-Endings.—Adrenaline has a specific action in stimulating the sympathetic myo-neural junction.

Drugs acting on the Eye.

Mydriatics cause dilatation of the pupil, and are represented by atropine, hyoscyamine (paralyze terminations of the third nerve), cocaine, adrenaline (stimulate terminations of the sympathetic).

Myotics cause contraction of the pupil.

Examples.—Pilocarpine (stimulates terminations of the third nerve), physostigmine (stimulates the iris muscle).

Agents acting on Tissue Change.

Tonics bring about increased functional activity, and restore vigour when from any cause an animal suffers from muscular or nervous depression. These agents may be classified as follows:

Cardiac Tonics.—See p. 72.

Hæmatic Tonics or **Hæmatinics** improve the quality of the blood by increasing the number of red corpuscles and the amount of hæmoglobin. They are represented by the various medicinal preparations of iron, and are employed in the treatment of anæmia, usually with small quantities of copper or cobalt.

Stomachic or Gastric Tonics.—See p. 62.

Nervine Tonics increase the tonus of the nervous system.

Examples.—Nux vomica and arsenic.

Intestinal Tonics impart tone to the intestinal muscles, and stimulate depressed peristalsis.

Examples.—Nux vomica and cascara sagrada.

Alteratives.—This term is very loosely applied to agents which are believed to produce favourable changes in the processes of nutrition and repair.

The term 'alterative' has been applied to arsenic, iodide of potassium, sulphur, calcium, iron, and antimony.

Febrifuges or **Antipyretics** lower abnormal temperature. Quinine reduces temperature by lessening the production of heat in the body, probably by inhibiting tissue change. Aconite acts as a febrifuge by depressing the circulation, and thus inhibiting the formation of heat.

A number of agents lower temperature by increasing the loss of heat. Antipyretics of the coal-tar series (antipyrin, antifebrin, phenacetin) produce their effect by decreasing heat production (action on heat-regulating centre), and also by increasing heat dissipation. Sweet spirit of nitre and alcohol dilate the cutaneous vessels and thus increase radiation.

Diaphoretics (agents which induce sweating) act as febrifuges by promoting the secretion of sweat. It is, however, difficult to elicit diaphoresis in animals (see p. 80).

In the horse, sponging the skin with tepid water, and then thoroughly drying and clothing the patient, assists in lowering abnormal temperature by directly abstracting heat and stimulating the functions of the skin.

It is to be realized that pyrexia is merely a symptom, and probably represents a manifestation of the reaction of the defensive forces of the body to the effects of the disease; the antipyretic treatment of fevers is therefore only rational when the febrile symptoms are so intense as to endanger life, or are at least the cause of great discomfort to the patient. In the treatment of hyperpyrexia such as is associated with the infective fevers, the temperature may be controlled by the use of simple salines, as magnesium sulphate and potassium nitrate, administered in the drinking water. Such agents probably act beneficially by causing the removal of toxic products from the tissues by way of the bowels and kidneys.

Venesection or Blood-letting.—By means of venesection blood-pressure is lowered and the force of the heart is lessened. In acute congestion of the lungs, the right side of the heart, the *venæ cavæ*, and the pulmonary vessels are engorged with blood, and the pulse is small and indistinct. In such a condition blood-letting relieves the cardiac distension and venous engorgement, and the pulse shows a marked improvement as regards volume and frequency. Formerly, blood-letting was extensively practised in many diseases, but is now seldom employed, and except in a very few conditions is not desirable. There is little doubt, however, that, in very acute pulmonary congestion in plethoric horses, blood-letting employed with discretion in the early stages proves of benefit. After venesection the volume of blood in the body is restored to normality in twenty-four to forty-eight hours.

Blood-letting is still, though rarely, practised in acute laminitis, lymphangitis, meningitis, and equine myoglobinuria (p. 478).

Local blood-letting or scarification is not now employed in veterinary practice.

Agents acting on the Skin.

Diaphoretics or Sudorifics increase the cutaneous secretions. In horses and cattle the action of diaphoretics is uncertain, and copious sweating is seldom produced by drugs. The administration of small and repeated doses of sweet spirit of nitre with solution of acetate of ammonium, and the application of warm clothing, may succeed in inducing diaphoresis.

Diaphoretics, such as sweet spirit of nitre and alcohol, produce

their effect by acting as vaso-dilators and increasing the cutaneous circulation. It is probable that they also stimulate the sweat centres in the cord or the nerves governing the sudoriparous glands.

In horses the vapour bath has been employed to produce sweating. Profuse diaphoresis can be experimentally produced in the horse by the intravenous injection of adrenaline.

In the dog and cat, as sweat glands occur only in the hairless pads of the feet, the production of diaphoresis is not attempted, although in carnivora pilocarpine causes sweating from the digital pads.

Diaphoretics are indicated in the early stages of infective fevers. In nephritis the promotion of sweat secretion relieves the kidneys and assists in removing waste products from the body.

The term SUDORIFIC is applied to a diaphoretic which acts powerfully.

Anhidrotics lessen the secretion of sweat. Atropine produces this effect by paralyzing the terminations of the nerves to the sweat glands.

Drugs acting on the Surface of the Body.

Counter-Irritants, according to the severity of their action, may be classified as follows:

(a) RUBEFACIENTS produce congestion of the cutaneous vessels. They are represented by mild applications of mustard paste, and liniments containing ammonia and oil of turpentine. The reddening of the skin which occurs in man as the result of the application of rubefacients is observed in animals only in parts where the skin is not pigmented.

(b) VESICANTS or EPISPASTICS cause the formation of vesicles or blisters on the skin. These contain plasma, and after a variable time they rupture, leaving a dry scale.

Examples.—Preparations of cantharidin and strong applications of mustard paste.

(c) SUPPURANTS or PUSTULANTS cause inflammation of the deep-seated structures of the skin and the formation of pustules.

Examples.—Biniodide of mercury, croton-oil. Vesicants, if applied in a too concentrated form, or if their application be repeated, have a similar effect.

The *actual cautery* is a powerful counter-irritant, and is occasionally employed in the treatment of diseased joints, ligaments, and tendons.

USES OF COUNTER-IRRITANTS.—Formerly, vesicants were freely applied to the thoracic walls in pneumonia and pleurisy.

Such measures are not only useless, but harmful, and the practice of indiscriminate blistering has now been almost entirely abandoned. It should be observed, however, that in such conditions a moderate rubefacient effect is often beneficial.

In chronic diseased conditions of joints, ligaments, and tendons, counter-irritation by means of the thermo-cautery is employed. In the case of tendons and ligaments, the beneficial effects of counter-irritation are believed to depend on its action in modifying the nutrition of the part, promoting absorption of exudate, and so favouring resolution.

In former times firing was practised indiscriminately, and even today many favourable results due really to the *vis medicatrix naturæ* are attributed to the employment of the actual cautery. It must now be realized that the prolonged rest which is necessary after firing is largely responsible for the beneficial effects obtained by its application.

The barbarous practice of firing limbs with a view to the prevention of disease conditions to which certain conformations were supposed to be subject is now discontinued.

Setons and rowels were formerly employed as methods of counter-irritation in the treatment of sinuses and fistulæ, and in cases of hip and shoulder lameness. Such measures have justly fallen into disrepute. Sinuses and fistulæ are now more rationally treated by surgical means.

In the *early* stages of acute bronchial and pulmonary affections the application of a rubefacient such as mustard paste to the chest walls frequently proves of benefit; such an application, while dilating the cutaneous bloodvessels, reflexly brings about constriction of those of the subjacent viscera and it is upon this effect that its value is believed partly to depend. The peripheral irritation also stimulates reflexly the vital centres in the medulla. In pain of abdominal origin the application of a mild counter-irritant, such as heat, may give speedy relief, and in the case of pain originating in a viscus, but which is referred to the abdominal wall, counter-irritation to the painful part is of particular service. Thus, fomentations to the epigastrium frequently relieve painful gastritis in the dog, the afferent nerves from the stomach ending in the same segment of the spinal cord as that to which the sensory nerves of the epigastrium belong.

In acute laryngitis and pharyngitis in the horse the application of a cantharidin blister to the external region of the throat is often beneficial. In strangles, when the abscess in the sub-maxillary space matures slowly, the application of mustard paste or a cantharidin blister hastens the process of maturation.

Cold and Hot Applications.—The application of cold water

lessens the supply of blood to a part by causing contraction of the capillaries (see p. 177). Hot applications dilate the capillaries, increase the superficial circulation, and diminish pain in an inflamed area (see p. 178).

Cataplasmata or **Poultices** relieve tension, pain, and inflammation, by supplying heat and moisture to the affected part (see p. 97).

Caustics destroy living tissue with which they are brought into contact. Those which produce an extensive slough are termed 'ESCHAROTICS.' Caustics are employed for the purpose of suppressing exuberant granulations in wounds. Nitrate of silver and sulphate of copper are the agents usually selected for this purpose. Caustics are also employed for the destruction of virus in wounds, and for the removal of warts when these cannot be readily excised.

In the surgical treatment of sinuses and fistulæ, caustics are still used, but operative measures are preferable.

Styptics or **Hæmostatics** are employed for the purpose of arresting hæmorrhage. Some act mechanically—*e.g.*, the application of pressure-pad or tourniquet, the surgical ligature, douching with hot water at 110° to 120° F. Others act by coagulating albumin, and so plugging the bleeding vessels—*e.g.*, alum, perchloride of iron, tannic acid; others by causing contraction of the capillaries—*e.g.*, adrenaline, ergot.

The actual cautery was at one time largely employed as a styptic, but is now superseded by other and less crude methods.

Astringents, when applied locally to wounds, cause contraction of the capillary vessels, coagulate albumin, lessen excessive discharges, and check the formation of exuberant granulations.

Examples.—Acetate of lead, sulphate of zinc, oxide of zinc, tannic acid.

Emollients soften and allay irritation of the skin.

Examples.—Oils, soft paraffin, and fats such as lanolin and suet.

Parasiticides.—This term is sometimes widely applied to the group of agents which includes germicides and vermicides, but is generally understood as referring only to those agents which destroy parasites on the skin. Parasiticides are employed in the treatment of mange, ringworm, pediculosis, etc.

Examples.—Derris, sulphur, coal-tar products, stavesacre.

Antipruritics allay itching and local irritation.

Examples.—Coal-tar preparations.

Keratolytics.—These dissolve scales on the surface of the skin and prevent their further formation. They are usually employed as ointments.

Examples.—Salicylic acid, coal-tar preparations, resorcin.

Agents acting on Bacteria and their Products.

Antiseptics are agents which inhibit or arrest the growth of pathogenic micro-organisms.

Disinfectants or **Germicides** destroy bacteria and their spores.

Although these terms are often treated as synonymous, there are many agents which are antiseptics—*i.e.*, they inhibit the growth of micro-organisms—while only a few are disinfectant or germicidal in their action. The strength of the solution employed may determine whether it will exert a germicidal (disinfectant) action or an inhibitory (antiseptic) action.

The first of the disinfectants used as such was carbolic acid, and the activity of a germicide is estimated by comparing its potency upon a micro-organism under set conditions with that of carbolic acid; the figure representing the comparative potency is known as the phenol coefficient. Chick and Martin have shown that the phenol coefficient is markedly affected by various factors: (1) The temperature, (2) the length of time for which the disinfectant is allowed to act, (3) the species of micro-organisms used in the test, (4) the quantity of organisms used, (5) the nature of the medium in which the organisms are suspended, and (6) the presence of other organic material. It will therefore be understood that the knowledge of the phenol coefficient of a germicide under one set of conditions is of limited value to the surgeon, as it may give little indication of the usefulness of the agent in actual practice. The value of an antiseptic has not to be alone estimated upon its power to destroy bacteria; many powerful germicides are quite unsuitable for surgical purposes because of their destructive action on living tissue cells.

A large number of coal-tar derivatives, in addition to carbolic acid—*e.g.*, creolin, chinol, acriflavine—are commonly used for surgical purposes.

Common salt in the form of a hypertonic solution (5 per cent.) may be regarded as one of the most valuable agents at our command in the treatment of septic wounds in the herbivora.

Perchloride of mercury and mercuric iodide are efficient germicides, but have certain disadvantages, of which their toxic nature is one of the most important.

Chlorine compounds, of which the best known in veterinary practice is eusol, are now much employed in surgery; while they are powerful germicides, they are practically non-toxic to tissue cells.

Compounds, containing a halogen derivative of xyleneol dissolved in essential oils, are recently introduced antiseptics; these

possess high germicidal properties; they are of low toxicity and are relatively non-irritant to the tissues.

Heat in the form of boiling water or as superheated steam produced under pressure is extensively used in the sterilization of surgical instruments.

Deodorants adsorb gases and also neutralize foul odours.

Examples.—Formalin, charcoal, hydrogen peroxide, solutions of permanganate of potash. Many disinfectants are deodorants, but it does not follow that because an agent removes foul smells it possesses germicidal powers.

PRESCRIBING AND PRESCRIPTION WRITING

A PRESCRIPTION is a written order to a pharmacist for the dispensing of certain drugs in certain amounts, giving directions as to compounding and administration.

Prescriptions are usually written in Latin, this language being universally understood by pharmacists, while it also affords a certain degree of secrecy, thereby obviating attempts at 'home doctoring,' which may be attended by pernicious results.

The classical prescription consists of the following parts:

1. The Superscription, represented by the symbol R., which is an abbreviation of *Recipe*—i.e., Take.

2. The Inscription, or body of the prescription, containing the names and quantities of the drugs to be employed.

3. The Subscription, or directions to the dispenser (written in Latin).

4. The Signature includes the directions to the attendant upon the animal with reference to the method of administration (preferably written in English because of the need for clarity of expression); this is preceded by the abbreviation *Sig.*, representing *Signa*—i.e., mark or label.

Then follows the prescriber's name or initials and the date. The name of the owner of the animal should appear on the prescription, and the animal for which the prescription is intended should also be mentioned; thus Mr. —'s grey mare, Mr. —'s fox-terrier, etc.

The composition of the classic inscription is based upon a maxim of Asclepiades rendered '*Curare cito tuto et jucunde*,' and consists of four drugs, each of which represents the words Cure, Quickly, Safely, and Pleasantly, respectively.

In such a prescription the ingredient with which it is hoped to effect a CURE is known as the **Basis**.

The second component is represented by a drug introduced to aid the action of the basis, so that it may produce its effects more QUICKLY; this is known as the **Adjuvant**.

The third component is designed to correct some undesirable property of the basis, so that it may be administered more SAFELY; it is known as the **Corrective**.

Finally, although animals—with few exceptions—do not regard

medicinal treatment PLEASANTLY, medicines may be given in a substance which may in part mask their unpleasant taste or obviate their harmful effects on the mouth and pharynx, or an agent may be added to convert the medicines into a form suitable for administration; this is known as the Vehicle or Excipient.

An illustration of the classic form of inscription may be found in a purgative bolus for a horse.

BASIS.—Powdered Barbadoes aloes (on which the purgative action depends). CURE.

ADJUVANT.—Powdered gentian (believed to aid the action of the aloes). QUICKLY.

CORRECTIVE.—Powdered ginger (regulating peristalsis and preventing griping). SAFELY.

VEHICLE or EXCIPIENT.—Treacle (renders the bolus of proper consistency for administration). PLEASANTLY.

It will be understood that it is unnecessary to base all inscriptions on such a complicated form. Frequently a basis alone is prescribed, with or without a simple vehicle.

As pharmacists are usually unfamiliar with veterinary posology, it is sometimes advisable, when prescribing potent drugs for the larger animals, to insert the letters Q.R. (*quantum rectum*) to show that it is really intended that such a quantity be prescribed, otherwise the pharmacist may decline to dispense the prescription. This is especially so in instances when there is an indication for the employment of a poisonous drug in doses much larger than those in which the drug is usually administered. Thus the powdered nux vomica is usually prescribed as a stomachic to the horse in doses of 1 drachm, but as a stimulant to intestinal peristalsis the dose prescribed may be seven or eight times that amount.

The noun which represents the name of a drug is put in the genitive case, and the quantities to be dispensed are put in the accusative, but the quantities are seldom written as words; they are usually expressed as symbols and numerals.

When no precise quantity is stated, the name of the medicine is put in the accusative case (for examples see prescriptions in Appendix III.).

The quantities of the weights or measures to be prescribed are shown in Roman numerals. A dot should be placed over each unit; this is done to minimize the chance of the pharmacist misreading the statements of quantity—thus i, ij, iij, iv, viij, etc.; for the same reason the last unit in a series is sometimes formed as a j.

The following text relating to the formation of the genitive case is based upon Fish's exposition of Mann's rules:

RULES FOR THE FORMATION OF THE GENITIVE CASE.

1. All nouns ending in *a* form the genitive in *æ*, as *quinina*—*quininæ*, but *coca* is unchanged. *Folia* is plural, genitive *foliorum*.

2. All nouns ending in *us*, *um*, *os*, *on*, form the genitive in *i*, as *conium*, *conii*. Exception, *flos*—*floris*. *Cornus*, *fructus*, *quercus*, *spiritus*, do not change.

3. All other nouns of whatever termination make the genitive in *s* or *is*—*chloral*, gen. *chloralis*. Some lengthen the termination thus:

<i>as</i> ,	genitive,	<i>atis</i> ,	as	<i>acetas</i> ,	<i>acetatis</i> .
<i>is</i> ,	„	<i>idis</i> ,	as	<i>anthemis</i> ,	<i>anthemidis</i> .
<i>o</i> ,	„	<i>onis</i> ,	as	<i>cusso</i> ,	<i>cussonis</i> .
<i>x</i> ,	„	<i>cis</i> ,	as	<i>cortex</i> ,	<i>corticis</i> .

There are a few exceptions: *Mas*, gen. *maris*; *phosphis*, *sulphis*, etc., gen. *itis*; *mucilago*, gen. *mucilaginis*, etc.

The following words do not change in their genitive: *Amyl*, *buchu*, *cajuputi*, *cannabis*, *catechu*, *coca*, *cornus*, *curare*, *digitalis*, *fructus*, *hydrastis*, *jaborandi*, *kino*, *quercus*, *sinapis*, *spiritus*.

The Dose.—This is the amount of a drug which it is safe to administer, and which is likely to produce desired effects. As already mentioned (p. 57), there are circumstances which lead us to modify the dose. The recognized doses are arranged from the smallest, to the largest that can be administered with safety. The size and vigour of the patient must necessarily be taken into account, and discrimination is required in computing the dose that will fulfil the conditions of efficiency and safety.

Rectal doses are usually double those given by the mouth; hypodermic doses of alkaloids should be about one-half the oral dose, and intravenous doses one-half or two-thirds of the hypodermic dose.

As a general rule, yearling horses take one-third of the dose suitable for an adult, two-year-olds one-half, and three-year-olds two-thirds, of the adult dose.

Dogs vary so much in size that great care must be observed in prescribing suitable doses, especially for the smaller breeds. It is always proper to commence treatment with small doses when powerful drugs, such as strychnine or arsenic, are prescribed. In computing the dosage, it is convenient to take as the standard a dog about the size of a fox-terrier, and in this book the doses given are computed according to this method.

Although in many instances the doses suitable for the dog are similar to those prescribed for the human subject, it is to be

observed that, in prescribing for small dogs, we cannot compute the safe doses from the posology adopted in human medicine. Further, there are certain drugs—such as nux vomica and strychnine—which, if administered even to large dogs in doses suitable for human beings, would prove toxic. Again, in order to induce catharsis, aloes must be given to the dog in relatively larger doses than those prescribed for man. On the other hand, calomel must be prescribed in relatively smaller doses for the dog than for man.

If we take as a standard the dose of a drug suitable for the dog, we may, with certain exceptions, compute the doses suitable for other animals as follows:

Cats.—One-half the dose.

Pigs.—Twice the dose.

Sheep and Goat.—Three times the dose.

Horse.—Sixteen times the dose.

Cattle.—Twenty-four times the dose.

In canine practice the doses of certain drugs are computed according to the weight of the animal; average weights are as follow:

	<i>Average Weight.</i>	
Griffons and Toy-terriers	3 to 5	lb.
Toy-Spaniels, Pugs	10 „ 12	„
Fox-terriers, Scottish Terriers	18 „ 25	„
Bulldogs and Field Spaniels	40 „ 45	„
Retrievers, Collies, Greyhounds	55 „ 65	„
Great Danes, Mastiffs	120	„

Abbreviations and Phrases used in Prescription Writing.

āā (ἀνὰ), *ana*—of each. When two or more consecutive ingredients are ordered in equal quantities, the abbreviation *āā* is placed after the last.

Ad. Up to (the full phrase being ‘quantum sufficiat ad’). This is used to signify that the vehicle is to be added until a certain quantity is reached; the name of the vehicle is expressed in the accusative case.

Add. Adde—add.

Admov. Admove—apply.

Aq. Bull. Aqua bulliens—boiling water.

Aq. Dest. Aqua destillata—distilled water.

Aq. Ferv. Aqua fervens—hot water.

Aq. Steril. Aqua sterilisata—sterilised water.

Aut. Or.

B.i.d. Bis in dies—twice daily.

Bol. Bolus—a ball.

Caps. Capsula—a capsule.

Cochl. Cochleare—a spoonful.

Cochl. mag. Cochleare magnum—a tablespoonful.

Cochl. mod. Cochleare modicum—a dessertspoonful.

Cochl. parv. Cochleare parvum—a teaspoonful.

Collut. Collutorium—a mouth wash.

Co. Compositus—a compound.

Collyr. Collyrium—an eye-wash.

ē. Cum—with.

- Cyath. vinar.* Cyathus vinarius—a wine glass.
Decoctum. A decoction.
Det. Detur, pl. Dentur—let be given.
Dies. In dies—daily.
Div. Divide—divide.
Div. in pulv. vi. Divide in pulveres sex—divide into six powders.
Elect. Electuarium—an electuary.
Ferv. Fervens—hot.
Ft. Fiat, pl. Fiant—let be made.
Ft. bol. vi. Fiant boli sex—let six boluses be made.
Ft.m. Fiat mistura—let a mixture be made.
Haust. Haustus—a draught.
In pulmento—in gruel.
Lin. Linimentum—a liniment.
Liq. Liquor—a liquor or liquid.
Lotio. A lotion.
M. Misce—mix.
Mist. Mistura—a mixture.
Mitte. Send.
Mor. dict. More dictu—in the manner directed.
Oculentum. An eye-application.
Pasta. A paste.
Pil. Pilula—a pill.
P.c. Post cibo—after feeding.
P. or Pulv. Pulvis—a powder; pl. pulveres—powders; pulverizatus—powdered.
Q.s. Quantum sufficiat—a sufficiency.
Rep. Repetatur—let it be repeated.
Ss. Semis—a half.
Sig. Signa—mark, or label; *Signetur*—let it be labelled.
Sp. or Spts. Spiritus—spirits.
Stat. Statim—immediately.
Talis. Such.
T.i.d. Ter in die—three times daily.
Tr. Tinctura—a tincture.
Ungt. Unguentum—an ointment.
Vel. Or.

WEIGHTS AND MEASURES

Imperial System.

WEIGHTS.

Avoirdupois.

Uncia : 1 ounce (symbol, 1 oz.) = $437\frac{1}{2}$ grains.

Libra : 1 pound (symbol, 1 lb.) = 16 ounces = 7,000 grains.

Apothecary.

Granum : 1 grain (symbol, gr. i.).

Drachma : 1 drachm (symbol, $\mathfrak{z}\text{i}$.) = 60 grains.

Uncia : 1 ounce (symbol, $\mathfrak{z}\text{i}$.) = 8 drachms = 480 grains.

The *Scruple* (symbol, \mathfrak{ss} .) = 20 grains) is still occasionally employed.

MEASURES.

Minimum : 1 minim (symbol, \mathfrak{m} i.).

Drachma : 1 fluid drachm (symbol, f. \mathfrak{z} i.) = 60 minims.

Uncia : 1 fluid ounce (symbol, f. \mathfrak{z} i.) = 8 fluid drachms = 480 minims.

Octarius : 1 pint (symbol, O i.) = 20 fluid ounces.

Congius : 1 gallon (symbol, C. i.) = 8 pints.

1 minim of water weighs approximately $\frac{9}{10}$ grain.

1 pint of water weighs approximately $1\frac{1}{4}$ pounds.

1 gallon of water weighs approximately 10 pounds.

Medicines are sometimes measured by the drop, but this is not always safe or accurate. A drop of a very mobile liquid is much smaller than a drop of water. The amount will also vary according to the size and form of the neck of the bottle from which it is measured.

Metric System.

The Metric System of Weights and Measures is now adopted in the British Pharmacopœia, but is not yet generally employed in prescriptions by practitioners in the United Kingdom.

The *gramme* (symbol G.), which is taken as the unit of weight, is the weight of a cubic centimetre of distilled water at 4° C. or 39.2° F.

The following are the approximate equivalents of the Metric to the Imperial System. They are not strictly accurate, but sufficiently so for practical purposes.

WEIGHTS.

0.065 gramme = 1 grain.

1 gramme = $15\frac{1}{2}$ grains.

4 grammes = 1 drachm.

28.5 grammes = 1 ounce (avoirdupois).

30 grammes = 1 ounce (apothecary).

1 kilogramme = 2 pounds $3\frac{1}{4}$ ounces.

MEASURES.

0.06 cubic centimetre = 1 minim.

1 cubic centimetre (symbol, c.c.) = 17 minims.

3.5 cubic centimetres = 1 fluid drachm.

28.5 cubic centimetres = 1 fluid ounce.

85 cubic centimetres = 3 fluid ounces.

225 cubic centimetres = 8 fluid ounces.

340 cubic centimetres = 12 fluid ounces.

460 cubic centimetres = 16 fluid ounces.

568 cubic centimetres = 1 pint.

1 litre (symbol, L.) = 1,000 cubic centimetres = 1 pint 15 fluid ounces.

The cubic centimetre is also known as the millilitre (symbol, m.l.).

Measuring by Domestic Utensils.

This method, in consequence of the variation in size of domestic utensils, cannot be accurate, but is often found convenient.

Teaspoons	=1 fluid drachm.
Dessertspoons	=2 fluid drachms.
Tablespoons	= $\frac{1}{2}$ fluid ounce.
Wineglasses	=2 to 2 $\frac{1}{2}$ fluid ounces.
Tea-cups	=5 to 7 fluid ounces.
Breakfast-cups	=8 to 10 fluid ounces.
Common tumblers	=8 to 10 fluid ounces.
A pint wine-bottle	=about 13 fluid ounces.
A quart wine-bottle	=about 27 fluid ounces.
<hr/>	
A Corbyn quart	=40 fluid ounces.
A Winchester quart	=80 fluid ounces.

In order to avoid possible errors on the part of the dispenser, the names of drugs should be written in full when the meaning of the abbreviated designations might be in doubt. Thus, the term *ac. hydroc. dil.* is wrong and dangerous, as it might signify dilute hydrochloric acid or dilute hydrocyanic acid. Similarly, the term *hyd. chlor.* might represent calomel or corrosive sublimate, and should not be used. (When prescribing B.P. drugs and their preparations the official abbreviations should always be adopted.)

The doses of mixtures are usually computed according to domestic measures—for the horse in wineglassfuls, and for the dog in tablespoonfuls, teaspoonfuls, etc. For the horse, mixtures are usually ordered in quantities of a pint; and for the dog, of from 2 to 8 ounces.

In computing the requisite amount of each drug for a certain quantity of mixture, so that each dose ordered will contain a medicinal dose of each of the constituents, first ascertain the number of doses the proposed quantity of mixture will contain, next decide the medicinal dose of each agent selected, then by multiplying the former by the latter the proper amounts will be obtained.

Example.

Superscription	{ R	
Inscription	{	Sod. Bicarb. .. gr. xl. = 40 grains.
	{	Tinct. Nuc. Vom. .. ℥xxiv. = 24 minims.
	{	Tinct. Gent. Co. .. ℥ii. = 2 drachms.
	{	Syr. Aurant. .. ii. = 2 drachms.
	{	Aquam ad ℥ii. = to 2 ounces.
Subscription	{	F.m. = Fiat mistura = Let a mixture be made.
Signature	{	Sig.: Give two teaspoonfuls twice daily.

The foregoing, which is a prescription for an alkaline stomachic mixture for a dog the size of a fox-terrier, contains eight doses,

each dose being equivalent to two teaspoonfuls. The amount of bicarbonate of soda in each dose is therefore 5 grains; of the tincture of nux vomica, 3 minims; of the compound tincture of gentian, 15 minims; and of the syrup of orange-peel, 15 minims.

Again, an 8-ounce bottle of mixture will contain about 16 tablespoonfuls, or 32 dessertspoonfuls, or 64 teaspoonfuls. A 4-ounce bottle will contain about 8 tablespoonfuls, or 16 dessertspoonfuls, or 32 teaspoonfuls.

In prescribing antiseptic or other solutions reference may be made to the following table. The amounts are not strictly accurate, as they are expressed so that fractions are avoided but for practical purposes they are sufficiently exact.

1 part to 1,000 parts = $\frac{1}{10}\%$	about $\frac{1}{2}$ gr. to f \bar{z} i. = 9 gr. to Oi.
1 " to 500 " = $\frac{1}{5}\%$	1 gr. to f \bar{z} i. = 18 gr. to Oi.
1 " to 100 " = 1%	4 $\frac{1}{2}$ gr. to f \bar{z} i. = 90 gr. to Oi.
1 " to 80 " = 1 $\frac{1}{4}\%$	5 $\frac{1}{2}$ gr. to f \bar{z} i. = 2 dr. to Oi.
1 " to 50 " = 2%	9 gr. to f \bar{z} i. = 3 dr. to Oi.
1 " to 40 " = 2 $\frac{1}{2}\%$	11 gr. to f \bar{z} i. = 3 $\frac{1}{2}$ dr. to Oi.
1 " to 20 " = 5%	22 gr. to f \bar{z} i. = 7 dr. to Oi.
1 " to 10 " = 10%	44 gr. to f \bar{z} i. = 1 $\frac{3}{4}$ oz. to Oi.
1 " to 5 " = 20%	1 $\frac{1}{2}$ dr. to f \bar{z} i. = 3 $\frac{1}{2}$ oz. to Oi.
1 " to 2 $\frac{1}{2}$ " = 40%	3 dr. to f \bar{z} i. = 7 $\frac{1}{4}$ oz. to Oi.
" to 2 " = 50%	3 $\frac{1}{2}$ dr. to f \bar{z} i. = 9 oz. to Oi.
1 " to 1 $\frac{1}{4}$ " = 80%	6 dr. to f \bar{z} i. = 14 $\frac{1}{2}$ oz. to Oi.

LEONARD'S METHOD OF REDUCING PERCENTAGES (FISH).

'RULE (1). Call the numerator of the fraction 1 grain.

'RULE (2). Double the first figure of the denominator and call this ounces. This will then give almost mathematically correct reductions.

'Thus, 1 to 1,000 would be 1 grain to 2 ounces; 1 to 2,000 would be 1 grain to 4 ounces; 1 to 3,000 would be 1 grain to 6 ounces; 1 to 4,000 would be 1 grain to 8 ounces; 1 to 5,000 would be 1 grain to 10 ounces, and so on. If you want 1 to 500, this would be 1 grain to 1 ounce, there being 480 (approximately 500) grains or minims to the ounce. One to 100 would be 5 grains to 1 ounce.

'By committing these two simple rules to memory an instantaneous reduction for any percentage mixture can be made to the apothecary's basis.'

INCOMPATIBILITY.

Certain agents should not be prescribed together, as, because of chemical, pharmacological, or physical reasons, the resulting combination is inert, dangerous, or inelegant.

CHEMICAL INCOMPATIBILITY.—It is unnecessary in a work of this kind to enter into a full discussion of this subject, and the following extracts from Bruce and Dilling give in group form merely a few of the more important combinations which lead to chemical incompatibility:

‘(a) *The Combination of an Acid Substance with an Alkaline Substance.*—Acids unite with hydrates, carbonates, bicarbonates, and oxides of heavy metals to form salts, and *vice versa*. In considering this group it should not be forgotten that there are certain substances in the Pharmacopœia which, while their names do not indicate the fact, are distinctly acid or alkaline in reaction. Thus acid in reaction are liquor arsenii et hydrargyri iodidi, liquors, syrups, and scale preparations of iron, liquid preparations of squill except the tincture, tinctura camphoræ composita, and tinctures of drugs of the tannic acid series. [In watery suspension bismuth subnitrate is acid, solutions of arsenious iodide, copper sulphate, alum and caffeine citrate are acid, and spiritus ætheris nitrosi is occasionally acid if kept for a prolonged period.] The following are alkaline: liquor plumbi subacetatis, and ammoniated spirits and tinctures.

‘(b) *The Combination of Alkalies or Alkaline Salts with Salts of Heavy Metals or Alkaloids.*—Most heavy metals possess insoluble oxides, hydroxides, and carbonates, and the combination of an alkali and a soluble salt of a heavy metal often produces precipitation of the hydroxide or carbonate of the metal. If an alkali be added to a solution of an alkaloidal salt, the alkali combines with the acid radical and sets the alkaloid free, and the latter, being usually insoluble in water, forms a precipitate which may be dangerous. Alkalies decompose chloral hydrate into chloroform.

‘(c) *The Combination of Soluble Salts of Heavy Metals with Alkaloids, with Tannic Acid or Vegetable Drugs containing them, or with Vegetable Preparations containing much Organic Matter,* may produce precipitation. If we desire to combine an iron salt with a bitter, calumba or quassia must be selected, as they contain no tannic acid.

‘(d) *The Combination of Oxidizable or Reducing Substances with Oxidizing Agents.*—Care should be observed in prescribing drugs that fall under either of these categories, and special consideration must be exercised before prescribing in combination such drugs as chromic acid, permanganate or chlorate of potassium, and phosphorus.

‘It should also be noted that alcoholic tinctures frequently hold in solution substances which are insoluble in water and are precipitated on its addition—*e.g.*, ammoniated tincture of quinine

and tincture of cannabis indica; and, again, that the addition of alcohol may precipitate from their solution water-soluble substances—*e.g.*, neutral salts.'

PHARMACOLOGICAL INCOMPATIBILITY refers to the mixture of two drugs which possess antagonistic pharmacological actions—*e.g.*, purgatives and intestinal astringents; nevertheless, such drugs are occasionally combined when a corrective effect is desired.

PHYSICAL INCOMPATIBILITY.—Certain substances, because of their physical properties, cannot be combined unless subjected to special treatment; thus oil and water cannot be mixed, but may be combined in the form of an emulsion. Certain salts are insoluble in water, but may be dispensed as a suspension.

THE ADMINISTRATION AND APPLICATION OF THERAPEUTIC AGENTS

Baths.—In equine practice the employment of baths, except in the case of parasitic diseases of the skin, is not general. The difficulty of rapidly drying the skin of the horse constitutes a serious objection to the practice. The vapour bath, however, has been found of marked value in the treatment of renal affections, rheumatism, the early stages of respiratory affections, and in parasitic diseases of the skin. Great care is necessary to avoid risk of chill.

In canine practice hot baths are frequently employed in the treatment of various affections. The temperature may range from 95° to 105° F. The patient should be thoroughly dried afterwards, and kept in surroundings of a proper temperature.

In summer, house dogs are washed once a week or once a fortnight, that their coats may be cleansed and freed from parasites. Warm water and soap is first employed, and then the coat is rinsed in lukewarm water. Thorough drying is essential, and in fine weather a brisk run after the bath is desirable. Irritant soaps should be avoided.

Boluses or BALLS.—A bolus is a convenient form in which medicine may be given to the horse, and when skilfully administered the patient is caused comparatively little discomfort.

In administering a bolus it is important to avoid exciting the animal. In order to prevent the head being raised too high, an assistant should keep his hand on the nose. The tongue is grasped with the left hand, and the bolus is held between three fingers of the right hand; the hand in the form of a cone is passed rapidly along the hard palate, and the bolus pushed gently into the region of the pharynx; the hand is then quickly withdrawn, and the tongue released. The animal's head should be held up until the ball is seen to pass along the oesophagus. The passage of the bolus into the oesophagus is facilitated by allowing the horse to drink a little water.

Some horses resent the administration of medicines in this form, the jaws being champed vigorously when the hand enters the mouth. In these cases, in order to avoid injury to the hand,

it may be necessary to employ a mouth-gag. The use of the 'balling-gun' is to be deprecated. Unskilful administration, as the result of which a bolus becomes broken in the horse's mouth, is frequently the cause of the animal's resenting on a future occasion the administration of medicine in this form.

In rare instances 'choking' has occurred as the result of a bolus having become lodged in the pharynx or upper portion of the œsophagus. It is more likely to occur when the horse violently resents the administration.

In CATTLE, medicines in solid form are seldom administered, as they enter the rumen, and thus are slow and uncertain in their action.

In the DOG, medicines are conveniently administered as pills or tablets, or enclosed in gelatin capsules. The pill is placed at the back of the tongue or may be enclosed in a piece of meat, which is usually readily enough accepted.

Cataplasmata or poultices possess emollient properties, and are employed for the local application of heat and moisture. They may be composed of linseed-meal, oatmeal, or bran, stirred into boiling water until a suitable consistency is obtained, and then cooled to the proper temperature before being applied.

Poultices prepared in this way have now been largely superseded by applications composed of kaolin and glycerin with antiseptic agents, and by hot compresses of boric lint. The modern substitutes are convenient, retain their heat and moisture for a long period, and, being of little weight, do not cause discomfort.

Poultices were at one time commonly used in the treatment of punctured wounds of the feet in the horse, but, very properly, this practice has been abandoned and is now replaced by the employment of warm antiseptic foot-baths.

Collutoria.—Mouth washes usually consist of watery solutions of mild antiseptic or astringent agents.

Collyria.—Eye lotions are fluid preparations applied by instillation by means of an 'eye dropper.'

Lamellæ.—Thin soft gelatin discs, containing an active agent, suitable for insertion into the conjunctival sac.

Draughts or DRENCHES.—Medicine in liquid form may be administered as a draught. In the HORSE care is necessary that the fluid does not enter the trachea and thus cause inhalation pneumonia. The animal's head should not be held too high, the tongue should be left perfectly free, and if the horse make an attempt to cough, the head must be immediately released. The draught should be administered slowly.

The bottle from which the draught is administered should be made of metal, but if a glass bottle be used this should be

of stout material to avoid the risk of breakage in the mouth. In laryngitis, bronchitis, and, indeed, in all respiratory affections, the administration of draughts should be avoided, as there is danger of fluid being inhaled during the sudden inspiratory efforts which immediately precede coughing.

In CATTLE, similar precautions are necessary. The animal's head should not be held too high, and the head and neck should be kept, as far as possible, in a straight line. Many fatalities occur from the ignorant and careless administration of draughts to cattle. The practice of administering draughts through the nostrils cannot be too strongly condemned.

The dangers attendant upon the administration of draughts to horses and cattle can now be avoided by the use of the stomach tube (p. 470).

In the DOG, medicines in the fluid form are usually administered with facility. The best method is to distend the cheek with the finger so as to form a pouch, into which the medicine is slowly poured. It readily finds its way through the teeth, and is usually swallowed without trouble.

Electuaries are medicines in a semi-fluid form, and are prepared with a basis such as honey or treacle; they are administered by placing the required dose between the molar teeth or on the back of the tongue. Their employment is indicated when swallowing is difficult, as in acute laryngitis or in tetanus. When horses refuse to take powders in the food, the medicine can be mixed in a small amount of treacle and administered as an electuary.

Emplastra (PLASTERS) are adhesive, solid medicated preparations for external application. The basis consists of such substance as Burgundy pitch, gum resin, oil, or resin, and the plaster is spread upon flexible material such as silk, cloth or leather.

Enemata (CLYSTERS) are fluid preparations which are injected into the rectum for the following purposes:

1. To procure evacuation of the bowels. For this purpose the simplest form consists in warm water in which soap is dissolved. The effect of such an enema is not only to cause expulsion of the *fæces* contained in the rectum, but, by reflex irritation, to stimulate peristalsis in the large colon. In the horse and ox enemata are most conveniently injected by means of a continuous flow pump, attached to which is a sufficient length of rubber tubing, to which in turn is fixed a gum-elastic tube about 2 feet long. The rectum is, as far as possible, cleared of its contents by the hand; the tube, well lubricated, is carefully introduced and the fluid slowly pumped in. In impaction of the colon the simple injection of fluids into the rectum is not likely to prove of much service, and

the long tube (6 feet in length), first recommended by F. Smith, may be utilized. With care it is possible to pass this tube to its full length. The tube should be well lubricated and passed in very slowly, the fluid being pumped in at the same time. As the bowel becomes distended, the instrument passes along with facility into the floating colon. It will be found that the tube is inclined to bend on itself, but with care and patience this can be overcome. Large quantities of fluid should be introduced.

In the treatment of intestinal obstruction in foals due to the retention of the meconium, reliance must chiefly be placed on enemata. A long gum-elastic rectum tube is employed.

For the dog, when a relatively large quantity of fluid is injected a rubber bulb enema syringe is employed.

The rectal injection of small quantities of glycerin offers a ready means of evacuating the bowel. Glycerin, being markedly hygroscopic, produces a mild irritation of the rectal mucous membrane and reflexly stimulates peristalsis in the large bowel; it, however, causes little or no discomfort to the patient.

2. Enemata consisting of boiled starch, medicated with opium, are intestinal sedatives and astringents in severe diarrhoea. They should be small in volume and injected very slowly, so that they may be retained.

3. In painful inflammatory conditions of the pelvic organs, enemata of warm water exert a soothing effect.

4. Enemata containing common salt or a decoction of quassia are employed to destroy and remove parasites (oxyurides) infesting the rectum of the horse.

5. Enemata may be composed of nutrient substances in a form which is capable of being readily absorbed by the rectum. They are employed in cases in which swallowing is difficult or impossible, and in the dog enemata containing peptonized beef are sometimes substituted for nutrient suppositories.

Fomenta.—FOMENTATIONS are employed to relax and soothe congested or inflamed parts. They lessen tension and abate pain, and are used in the treatment of strains and contusions. Fomentations consist of hot water to which drugs may be added. The temperature of the water should not be too high; if above 110° F. irritation of the skin is produced. The attendant should judge the proper temperature by placing his elbow in the water; his hand is not a proper guide, because, particularly in the case of manual workers, it is unable to appreciate excessive heat. Care is necessary in prescribing fomentations, as many animals (particularly horses and dogs) have remarkably sensitive skins. In severe strains of tendons, more favourable effects are usually obtained by applying a large hot application of kaolin and

glycerin, and enveloping the limb in cotton-wool. In punctured wounds of the foot, after free drainage has been provided, the part should be kept immersed for several hours daily in a clean tub containing a hot antiseptic solution.

Hypodermic or Subcutaneous Injections.—Certain agents may be administered by hypodermic injection. Strict aseptic precautions should be observed. In horses and cattle the site usually chosen for injection is the lower region of the neck, and in sheep, young pigs and dogs the inner aspect of the thigh—*i.e.*, where the skin is thin and the subcutaneous tissue loose; in the case of boars and large sows the loose skin behind the ears is a convenient site of injection. A fold of skin is taken up between the finger and thumb, the needle is then passed through the skin in an oblique direction, and the contents of the syringe slowly injected.

For the subcutaneous injection of relatively large quantities of fluid a large syringe (100 to 200 c.c. capacity) is used, or an indiarubber bulb syringe (Higginson's pattern) fitted with a hypodermic needle may be employed. For the subcutaneous introduction of fluids by gravitation a simple apparatus can be constructed with a glass funnel and a piece of indiarubber tubing to which is attached a hypodermic needle. Subcutaneous injection should be performed slowly, and when large quantities of chemical solutions (as distinct from sera) are administered these should be heated to a temperature considerably above that of the body. All apparatus employed must be sterilized before and after use.

Intramammary Injections.—These have been found to be practically valueless in the treatment of acute staphylococcal mastitis. The injection of dilute solutions of relatively non-irritant antiseptics—such as 1 in 10,000 acriflavine—has been shown to be of some value in the treatment of chronic and sub-acute streptococcal mastitis.

Intramammary insufflation with air is still employed in the treatment of milk fever.

Intramuscular Injections.—Muscle is very vascular, but possesses few sensory nerves. The gluteal muscles offer a suitable site for the injection of slightly irritant and oily substances.

Intraperitoneal Injections.—The injection of chloral hydrate into the peritoneal cavity is employed on the Continent for the production of general anaesthesia. By intraperitoneal injection normal saline solution may be introduced in conditions of collapse. A fine trocar and cannula is inserted into the upper region of the left flank with strict aseptic precautions; the trocar is withdrawn and a syringe attached to the cannula. The method has not found favour in this country.

Intraspinal (Epidural) Injections for the production of spinal anæsthesia are occasionally employed. A sterilized solution of stovaine or novocaine is injected with strict aseptic precautions into the epidural space. Anæsthesia of the posterior portions of the body results (see p. 477).

Intratracheal Injection.—This method is frequently employed in the treatment of parasitic bronchitis in calves and lambs. A combination of vermicide drugs in emulsion is injected into the trachea, and thus acts directly on the parasites. A strong needle is required, and this is inserted into one of the inter-annular spaces; the syringe containing the solution is then attached to the needle, and the fluid slowly injected (p. 473).

Intra-Uterine Injections are employed in cases of septic conditions of the uterus. A 1 per cent. solution of liquor cresol saponatus forms a reliable germicide for such cases. It is best injected by means of a continuous flow syringe attached to a double tube, so that the fluid can be syphoned off, and the uterus thus thoroughly irrigated (see p. 476).

In post-partum hæmorrhage, the intra-uterine injection of hot water (110° to 120° F.) is hæmostatic.

Intravenous Injections.—The jugular vein is the vessel usually selected. The vein is raised by means of pressure exerted below the site of injection. The needle is carefully inserted with the point directed towards the head. When blood issues from the needle, it indicates that the vein has been entered. The injection should be made very slowly, care being taken that no air is permitted to enter the vein. The drugs to be injected must be completely dissolved and the solution dilute. Intravenous injection is commonly employed for the administration of formalin, calcium gluconate, and normal saline solution. Strict aseptic precautions are necessary, as septicæmia and septic phlebitis may arise as the result of their neglect. The intra-venous injection of irritant drugs such as formalin and calcium chloride must be very perfectly performed, as leakage into the surrounding tissues may result in local abscess and necrosis.

In the dog the saphenous vein may be selected as the site of injection.

Pessus.—PESSARIES are solid bodies, conical in shape, usually containing antiseptic agents, and intended for insertion into the uterine cavity or vagina. As a routine practice, antiseptic pessaries may be introduced into the uterus after the removal of retained placental membranes.

Powders are a safe and convenient method of administering medicines to the horse and dog. They should not contain substances having a disagreeable taste or smell, as otherwise

they will be refused by the patient. Powders are given to the horse either in the food or drinking water. If possessing any taste or smell, they should be first mixed in cold bran mash and then incorporated with the food. If mixed with warm food, their smell and taste are accentuated. Salines and mild alkalies are readily taken in the drinking water.

In the dog, medicinal agents, when mixed with sugar, are usually taken in the food without difficulty; or tasteless powders can be placed on the back of the tongue.

Suppositoria.—**SUPPOSITORIES** are soft conical bodies which are inserted into the rectum. Glycerin suppositories (containing 70 per cent. by weight of glycerin) are used in constipation in the dog. Nutrient suppositories containing peptonized beef are employed in canine practice when feeding by the mouth is impossible; they are also useful in acute gastritis with persistent vomiting.

When rectal feeding is being carried out, it may be necessary to administer an enema every few days to clear the bowel.

Vapores—**INHALATIONS.**—The inhalation of water vapour medicated with various agents is of value in respiratory affections. A perfect method of administration has not yet been devised for the horse. The usual plan is to fill a stable bucket three-quarters full of boiling water, pour in the medicinal agent selected, which is usually some antiseptic volatile oil, cover the top of the receptacle with hay, stir the contents, and hold the animal's head over the vapour which arises.

The practice of covering the horse's head with a sack containing the bucket should not be followed, as it frequently distresses the patient.

VETERINARY PHARMACY

PHARMACY is the art of preparing, compounding, and dispensing medicines, but the preparation of drugs in a form suitable for compounding lies within the sphere of the manufacturing chemist.

By COMPOUNDING is meant the art of mixing, combining, or otherwise treating the prepared drugs so that they may be dispensed according to prescription.

DISPENSING, strictly speaking, refers to the placing of the compounded drugs in suitable carriers—bottles, boxes, papers, etc.—and the wrapping and labelling of these.

The arts of compounding and dispensing can be learned only at the dispensing bench, and the more common pharmaceutical methods will be merely indicated here.

Pulveres.—POWDERS are prepared by reducing drugs by trituration to a state of fine division and thoroughly mixing them. Trituration and mixing are performed in the pharmacy by means of pestle and mortar. It is usual to supply quantities of six or twelve powders to each case. In the case of simple drugs, we first decide the dose of each agent, and by multiplying this by the number of powders to be sent we compute the weight of ingredient which is required. After thoroughly mixing by each pestle and mortar, we divide the bulk into the requisite number of powders and fold each dose neatly in paper. The powders are then put together in a wrapper and labelled.

When there is prescribed a combination containing poisonous agents such as arsenic, the dispenser first divides the simple drugs into the requisite number of powders; he then weighs each dose of the poisonous agent separately, and adds it to each of the powders.

In canine practice, triturations are convenient in the case of drugs such as arsenic. For example, the dose of this agent varies from $\frac{1}{80}$ to $\frac{1}{20}$ of a grain, according to the size of the dog. If we triturate 3 grains of arsenic with 10 drachms of milk-sugar, then 10 grains of the resulting triturate will be equivalent to $\frac{1}{20}$ grain. As a general rule it is safer and more accurate to prescribe highly poisonous drugs such as arsenic in the form of tablets.

In prescribing powders, it is desirable to avoid the inclusion

of hygroscopic agents, otherwise a damp useless mass will result.

Boluses or **Balls** are prepared by finely powdering and mixing the ingredients in a mortar with a pestle, and adding encipients such as soap, syrup, treacle, etc., so as to form a mass of proper consistence. The mass is then divided into the requisite number of doses, and each is moulded into the proper shape, which should be elongated and rounded at each end. The ball is then wrapped in thin paper.

Drugs such as chloral hydrate, salicylic acid, etc., can be administered in the solid form by means of gelatin capsules. These capsules are obtained in various sizes, and filled as required for use.

Pilulæ.—**PILLS** are spherical solid bodies intended to be swallowed whole, and are prepared by mixing the ingredients with a basis such as soap, treacle, etc., on a slab, and dividing the mass by means of a pill machine into the requisite number of doses, each of which is rolled into a pill.

Electuarium.—An **ELECTUARY** or **LINCTUS** is prepared by mixing the agents selected with a basis composed of honey or treacle. The consistence should be such that the preparation can be placed on the tongue with facility. If too fluid, the consistence can be increased by the addition of powdered liquorice. Various medicinal agents can be administered in the form of electuary, and in respiratory affections, especially, this method of medication is preferable to the administration of draughts.

Misturæ.—**MIXTURES** are preparations for internal use, and consist of one or more drugs dissolved or suspended in a fluid medium. Mixtures contain two or more doses, and these represent the capacities of domestic measures such as the teaspoon, the tablespoon, the wineglass, etc. Mixtures for horses and cattle are usually dispensed in quantities of a pint, and administered in doses of one wineglassful with a sufficient quantity of water. For the dog and cat, mixtures are dispensed in 2, 4, 6, or 8 ounce bottles, and administered in tea, dessert, or tablespoonful doses.

Hauftus.—A **DRAUGHT** is a liquid preparation for administration by the mouth. A draught differs from a mixture in that it is composed of a single dose only.

Injectiones Hypodermicæ.—**HYPODERMIC INJECTIONS** are conveniently prepared from pellets containing a stated dose of the drug to be injected, which is usually an alkaloidal salt. The pellet is dissolved in a small amount of sterilized water. It is important to ascertain that the whole pellet (*i.e.*, both the carrier material, which usually represents the bulk of the pellet,

and the contained drug) is in solution before the injection is made. In some hypodermic pellets the carrier material dissolves rapidly, and unless time is allowed for complete solution, the drug will be injected in the solid state or will fail to be sucked up by the hypodermic syringe.

Unguenta.—OINTMENTS are semi-solid preparations for external application, and have either a fatty substance (lard, lanolin) or else soft paraffin as a basis. In preparing ointments in bulk, the ingredients are first finely powdered and incorporated, the basis is melted, and the preparation is completed by thoroughly mixing together in a pestle and mortar, or by means of a slab and spatula. When it is desired that the ointment should penetrate the skin, a basis of animal origin such as lard should be selected.

Emulsions represent particles of oils or resins in a fine state of division, and suspended in a viscous aqueous vehicle. There is also required a third agent which will prevent the temporary coalescence of the two physically incompatible substances; this is known as the emulsifying agent or the emulgent. Emulsions have the appearance of milk.

Oils are emulsified with gum acacia or gum tragacanth, and occasionally with albumin, represented by yolk of egg. Resins are emulsified with a gum, which acts in the same manner as the gum contained in gum-resins (*q.v.*). The process of saponification of a portion of the oil by the addition of an alkali is a convenient method of dispersing an oil into a fine state of division.

Whichever emulsifying agent is used, the object of the pharmacist is the same—namely, to render the substance to be emulsified in a fine state of division and to isolate each particle by surrounding it with a film of gum, soap, or albumin, as the case may be.

When oils are to be emulsified with gum, the requisite amounts of the powdered gum and water (or the gum mucilage) are placed in a mortar and the oil is added in small portions. No addition of oil should be made until each portion has been incorporated with the mucilage. Of the gums, acacia is preferred to tragacanth; $\frac{3}{4}$ part of mucilage of acacia is required to emulsify 1 part of most of the fixed oils.

Alkaline emulsions of oils are simply prepared by placing the oil and alkaline solution in a bottle and shaking vigorously—*e.g.*, Linimentum Calcis.

Suspension.—Heavy insoluble powders may be suspended in a gummy or albuminous vehicle or in glycerin, the preparation being known as a suspension.

PART II

THE MATERIA MEDICA

INTRODUCTORY

As no official Veterinary Pharmacopœia exists, the veterinary practitioner adopts the preparations of drugs contained in the British Pharmacopœia, which is published by the General Medical Council and new editions of which are issued periodically. The last edition was published in 1932, and addenda were published in 1936, 1940 and 1941.

All drugs and preparations of drugs which appear in the Pharmacopœia are said to be 'official,' and to the names of such drugs and their preparations the letters 'B.P.' (British Pharmacopœia) may be attached. Certain preparations of drugs, while not appearing in the British Pharmacopœia, are contained in the 'British Pharmaceutical Codex,' a book issued under the authority of the Pharmaceutical Society of Great Britain. When prescribed, such preparations should have the letters 'B.P.C.' placed after them as an indication to the pharmacist of their identity.

The student should be familiar with the meaning of the following terms. They refer to the more common forms in which crude drugs appear in pharmacy, and to the preparations in which they are dispensed.

Aquæ (Waters) are prepared either by distilling the drug with water and preserving the distillate, or by making a simple solution of the agent in distilled water.

Examples.—Aqua Chloroformi; Aqua Rosæ.

Aceta (Vinegars) prepared by dissolving the active principles of a drug in acetic acid or by macerating the drug itself in acetic acid.

Example.—Acetum Cantharidini.

Decocta (Decoctions) are prepared by boiling the drug in distilled water for a certain time and then straining.

Example.—Decoctum Hæmatoxyli.

Infusa (Infusions) are prepared by treating the prepared drug with boiling water, and then straining.

Example.—Infusum Digitalis.

Tincturæ (Tinctures) are solutions of medicinal agents in alcohol. The mode of preparation varies; thus, some tinctures are prepared by a simple solution of the drug in alcohol, others by a process of maceration, and others, again, by maceration with a portion of the alcohol for forty-eight hours, followed by percolation with the remainder. In some instances a tincture is prepared with the standardized fluid extract of the drug and alcohol.

Examples.—*Tinctura Nucis Vomicae*; *Tinctura Opii*; *Tinctura Aconiti*.

Extracta (Extracts) may be solid, semi-solid, or liquid. Solid extracts are prepared by exhausting the drug by maceration or percolation with a suitable menstruum, and subsequently removing the bulk of this by evaporation.

Examples.—*Extractum Belladonnæ Siccum* (dry extract of belladonna); *Extractum Nucis Vomicae Siccum*.

Liquid or fluid extracts are prepared in a manner similar to the above, but the evaporation process is not carried so far, and rectified spirit, ether, or, in the case of aqueous extracts, chloroform water is added for the purpose of preserving the fluid.

Examples.—*Extractum Belladonnæ Liquidum*; *Extractum Nucis Vomicae Liquidum*.

Glycerina (Glycerins) are solutions of various drugs in glycerin.

Examples.—*Glycerinum Boracis*; *Glycerinum Phenolis*.

Mellita (Honey) are thick liquid preparations containing honey.

Example.—*Mel Boracis*.

Spiritus (Spirits) are solutions of drugs in rectified spirit.

Example.—*Spiritus Camphoræ*.

Commonly they are solutions of volatile oils in rectified spirit.

Example.—*Spiritus Anisi*.

Liquores (Liquors) are solutions of medicinal agents in water, and in many instances the process of preparation is complex.

Examples.—*Liquor Ammonii Acetatis Fortis*; *Liquor Arsenicalis*.

Syrupi (Syrups) consist of a strong solution of refined sugar in distilled water, to which is added the medicinal agent in a state of solution.

Examples.—*Syrupus Scillæ*; *Syrupus Tolutanus*.

Misturæ (Mixtures) are fluid preparations consisting of one or more drugs dissolved in water or suspended in some thick fluid. They are intended for internal use.

Example.—*Mistura Cretæ*.

Pulveres (Powders) are mixtures of finely powdered drugs.

Example.—*Pulvis Ipecacuanhæ et Opii* (see p. 325).

Pilulæ (Pills).—There are several official pill masses.

Example.—*Pilula Colocynthis Composita*.

Linimenta (Liniments) are fluid preparations which have an oily, soapy, or alcoholic basis, and are intended for external use, being either applied to the skin with friction or simply painted upon it.

Example.—Linimentum Terebinthinæ.

Lotiones (Lotions) are solutions intended for external use, and are usually washed upon the affected part.

Example.—Lotio Hydrargyri Flava.

Unguenta (Ointments).—See p. 105.

Oculenta (Ointments for the Eye).—The basis in each case is prepared by melting together 90 parts by weight of yellow soft paraffin and 10 parts by weight of wool-fat.

Example.—Oculentum Hydrargyri Oxidi.

Lamellæ (Discs).—The basis of these preparations consists of gelatin to which some glycerin has been added. Lamellæ are employed for the introduction of certain drugs into the eye.

Examples.—Lamellæ Homatropinæ; Lamellæ Physostigminæ.

Alkaloids commonly represent the active principles of vegetable drugs; they are alkaline in reaction, and readily combine with acids, forming salts soluble in water. All contain nitrogen. Some drugs may contain more than one alkaloid, and the actions of these may be antagonistic. Alkaloids have the termination 'ine' or 'ina.'

Examples.—Morphine; Atropine; Physostigmine; Cocaine.

Neutral Organic Principles are complex crystalline bodies, the precise chemical nature of which is unknown.

Neutral principles have the termination 'in' or 'inum.'

Examples.—Aloin; Santonin.

Glucosides are neutral principles, which split up into glucose and other substances (alcohols, aldehydes, etc.) when acted upon by acids or ferments in the presence of moisture and warmth.

Examples.—Salicin; Digitalin.

Fixed Oils are obtained by expression, and cannot be distilled without decomposition. They are liquid at ordinary temperatures, cause a greasy mark on paper, and are soluble in chloroform and ether, but insoluble in water.

Examples.—Oleum Olivæ; Oleum Morrhuæ.

Fats are fixed oils which are solid at ordinary temperatures.

Example.—Adeps.

Volatile, Ethereal, or Essential Oils are usually obtained by distillation. They do not cause a greasy mark on paper. They are soluble in alcohol, chloroform, and ether, and, while but slightly soluble in water, they impart to it their odour and taste, all being markedly aromatic.

Examples.—Oleum Eucalypti; Oleum Anisi.

Cera (Wax) occurs as the result of the combination of fatty acids with heavy monohydric alcohols.

Example.—Cera Flava.

Gummi (Gums) are viscid bodies obtained by exudation from the stems of certain plants. Their principal constituents are arabin and bassorin.

Examples.—Acacia; Tragacanth.

Resins are solid brittle bodies of a complex chemical nature. They are insoluble in water, but soluble in alcohol and alkaline solutions, hence aloes and other drugs containing resins are rendered more soluble in water by the addition of alcohol or an alkali.

Examples.—Jalap; Scammony.

Gum-Resins are obtained from plants by exudation, and principally consist of a mixture of gums and resins. When rubbed up with water they form an emulsion, the gum passing into solution and holding the resin in suspension.

Example.—Myrrha.

Oleo-Resins are complex chemical bodies which result from the natural solution of a resin in a volatile oil.

Example.—Copaiba.

Mucilagines (Mucilages) are preparations containing gum in suspension or solution.

Example.—Mucilago Acaciæ.

The Materia Medica

may be divided into the following groups for convenience of description:

GROUP I.—Alkalies and alkaline earths.

GROUP II.—The metals.

GROUP III.—The metalloids.

GROUP IV.—The non-metallic elements.

GROUP V.—Acids.

GROUP VI.—Water and oxygen.

GROUP VII.—Carbon and its compounds.

GROUP VIII.—The vegetable kingdom.

GROUP IX.—The animal kingdom.

GROUP I—ALKALIES AND ALKALINE EARTHS.

Of these the most important are: (1) Potassium, (2) Sodium, (3) Ammonium, (4) Calcium, (5) Magnesium, (6) Barium.

POTASSIUM.

Potassii Hydroxidum (Pot. Hydrox.).—Potassium Hydroxide; Potassium Hydrate; Caustic Potash; KOH.

Source.—Prepared by the interaction of potassium carbonate and calcium hydroxide. It contains not less than 85 per cent. of pure KOH.

Characters.—White pencils or cakes, hard but very deliquescent, powerfully alkaline and corrosive. *Solubility*.—2 in 1 of water; 1 in 3 of alcohol 90 per cent.

Liquor Potassii Hydroxidi (Liq. Pot. Hydrox.).—Liquor Potassæ; Solution of Potash. 5 g. of KOH in 100 ml. of water, or 5 gr. in 110 min.

Characters.—A colourless, odourless, strongly alkaline fluid; feeling soapy when rubbed between the fingers. Sp. gr. 1.045. *Incompatible* with acid substances, heavy metallic salts, alkaloids. *Impurities*.—Carbonates, sulphates and chlorides; other metals.

GENERAL ACTIONS.—Potassium salts are rapidly absorbed and quickly excreted.

The action of the potassium ion is depressant to the central nervous system and to muscle, including that of the heart, but when the salts are given by mouth their excretion is so rapid that their action is elicited only by their respective acid radicals.

ACTIONS.—*Externally* potassium hydroxide is a penetrating caustic, and its action in this respect is difficult to control. Dilute solutions of caustic potash saponify fatty matters present on the surface of the skin.

Internally, it is an irritant corrosive poison.

USES.—*Externally*, caustic potash is employed as an application to prevent the growth of horns in young cattle. It is seldom used as a caustic. Because of its detergent properties it is sometimes added to parasiticide dressings to increase their penetrating power.

Internally, neither potassium hydroxide nor the liquor potassæ is prescribed.

Potassii Carbonas (Pot. Carb.).—Potassium Carbonate; K_2CO_3 .

Source.—Obtained by the interaction of potassium sulphate and calcium carbonate. Contains not less than 81.5 per cent. pure K_2CO_3 .

Characters.—A white, crystalline, very deliquescent powder; taste caustic and alkaline. *Solubility*.—1 in 1 of water; insoluble in alcohol 90 per cent. 20 parts neutralize 17 parts of citric acid, or 18 parts of tartaric acid. *Incompatible* with acid substances, heavy metallic salts, alkaloidal preparations. *Impurities*.—Other metals; sulphates, thiosulphates and chlorides.

Potassii Bicarbonas (Pot. Bicarb.).—Potassium Bicarbonate; $KHCO_3$.

Source.—Made by saturating a strong aqueous solution of the carbonate with carbon dioxide.

Characters.—Colourless monoclinic prisms, not deliquescent; taste saline, feebly alkaline; not corrosive. *Solubility*.—1 in 4 of water; insoluble in alcohol 90 per cent. 20 parts neutralize 14 parts

of citric acid, or 15 parts of tartaric acid. *Incompatible* with acid substances, alkaloids and magnesium sulphate. *Impurities*.—As of the carbonate.

DOSES.—Horses, \mathfrak{z} ss. to \mathfrak{z} i.; cattle, \mathfrak{z} i. to \mathfrak{z} i.ss.; sheep and pigs, \mathfrak{z} ss. to \mathfrak{z} i.; dogs, grs. x. to grs. xl. Administered twice daily, either mixed in the food or dissolved in the drinking water.

ACTIONS.—*Externally*, both salts act as detergents and sedatives to the skin.

Internally, the carbonate in toxic doses and in concentrated form is an irritant corrosive poison. The bicarbonate does not possess this irritating effect, and is the salt prescribed for internal use. It is an antacid; it increases the alkalinity of the blood and urine, and acts as a mild saline diuretic (see p. 67).

Like other soluble alkalies, bicarbonate of potassium exerts an inhibitory action on the gastric glands if given before or during feeding.

MEDICINAL USES.—*Externally*, carbonate of potassium is added to applications for the treatment of parasitic skin diseases. It softens the cuticle, and facilitates the action of the parasiticide.

An emulsion of carbonate of potassium, olive-oil, and water, forms a useful dressing for blistered surfaces (see p. 572).

Internally, in dyspepsia, accompanied by hyperacidity, bicarbonate of potassium acts as a direct antacid, but the bicarbonate of soda is preferred for this purpose.

In rheumatism, the bicarbonate is prescribed as an antacid and alterative; it neutralizes excess of acid in the tissues, increases the flow of urine, and renders it alkaline.

In cystitis and in irritable conditions of the bladder, the bicarbonate is prescribed in combination with hyoscyamus; it tends to render the urine alkaline, and reduces vesical irritability.

Potassii Nitras (Pot. Nitras).—Potassium Nitrate; Nitre; Saltpetre; KNO_3 .

Source.—Obtained native, chiefly in the surface soil of India, and purified by crystallization from solution in water, or by interaction of sodium nitrate and potassium chloride.

Characters.—Striated, six-sided colourless prisms, or white crystalline masses; taste cool, saline. **Solubility**—1 in 4 of water. **Impurities.**—Sulphates, chlorides, and other metals.

Doses.—Horses, \mathfrak{z} ss. to \mathfrak{z} ii.; cattle, \mathfrak{z} ii.; sheep and pigs, \mathfrak{z} ss.; dogs, grs. ii. to grs. x. Repeated twice daily.

ACTIONS.—*Externally*, potassium nitrate is refrigerant.

Internally, nitrate of potassium is an alterative, febrifuge, and diuretic. It is excreted chiefly by the kidneys, and acts as a saline diuretic. It is also excreted to some slight extent by the skin and is a mild diaphoretic. It is not excreted by the respiratory mucous membrane, but increases the fluidity of the bronchial secretion and is expectorant.

TOXIC ACTIONS.—Toxic doses cause fatal gastro-enteritis, irritate the kidneys, and paralyze the heart and nervous centres. Fatal poisoning has occurred in cattle as the result of this agent being administered in mistake for Epsom salt. Potassium nitrate is a constituent of brine used for pickling purposes, and probably contributes to the production of so-called brine poisoning in swine. Poisoning may occur in fowls by their picking crystals from sacks which have contained sodium nitrate.

ANTIDOTES.—Mucilaginous substances, such as linseed-tea, white of egg, olive-oil, etc., should be freely administered. If collapse supervenes, stimulants are indicated.

MEDICINAL USES.—*Externally*, potassium nitrate is employed in combination with ammonium chloride and water as a refrigerating lotion in the proportions 1:1:16 respectively.

Internally, nitrate of potassium is frequently prescribed in febrile conditions and catarrhal affections. It acts beneficially by promoting bronchial, cutaneous, and urinary secretion, and assisting in the elimination of effete products. For these purposes it is combined with febrifuge doses of magnesium sulphate, and is readily taken when dissolved in the patient's drinking water.

As a diuretic, it is largely employed in œdematous conditions of the limbs, and in lymphangitis. In acute inflammatory conditions of the kidneys potassium acetate is preferred to the nitrate, since the latter is believed to cause marked dilatation of the renal bloodvessels.

Potassii Chloras (Pot. Chloras).—Potassium Chlorate; KClO_3 .

Source.—Made by passing chlorine gas into water containing lime or magnesia in suspension, treating the clarified liquid with potassium chloride, and crystallizing.

Characters.—Colourless monoclinic crystals; taste cool, saline. Explodes when rubbed with sulphur or sulphides. **Solubility.**—1 in 16 of water; almost insoluble in glycerin. **Incompatible** with sulphur, ferrous salts, tannin, and other oxidizable substances, e.g., sugar.

DOSES.—Horses, ʒii. ; cattle, ʒss. ; sheep and pigs, grs. xx. to grs. xl.; dogs, grs. v. to grs. xv. Repeated twice daily.

ACTIONS.—*Externally*, chlorate of potassium is a local stimulant, and also possesses feeble antiseptic actions.

Internally, it increases the secretion of the salivary and buccal glands; it also stimulates bronchial secretion, thus acting as an expectorant. Formerly it was believed to become reduced in the body and to give up oxygen to the tissues, but 90 to 95 per cent. of the drug can be recovered in the urine. When the drug comes in contact with septic matter it undergoes slow reduction with elimination of oxygen, and its beneficial effects in septic conditions of the mouth and pharynx, and in

cystitis with decomposition of the urine, are thus explained. It is excreted chiefly by the urine, and by the salivary glands, the bronchial and nasal mucosæ, in an unchanged condition.

TOXIC ACTIONS.—Toxic doses cause gastro-intestinal irritation. Oxygenation in the blood is interfered with, and hæmoglobin may be largely converted into methæmoglobin, in which case death occurs from asphyxia. The urine is of a dark brown colour, and contains albumin, hæmoglobin, and not infrequently blood-casts. Anuria, uræmia, and jaundice may occur. On post-mortem, gastro-enteritis, cystitis, and nephritis are present.

MEDICINAL USES.—*Externally*, chlorate of potassium in solution (2 or 3 per cent.) forms a useful mouth-wash in stomatitis. For this purpose it is combined with borax, honey, and water.

Internally, chlorate of potassium is employed in laryngitis, pharyngitis, and bronchitis. It may be administered in the drinking water, or in electuary.

In prescribing the drug large doses should be avoided, as they are likely to produce gastro-intestinal irritation. It is sometimes employed in purpura hæmorrhagica, but its value is very doubtful. In catarrh of the bladder associated with decomposition of the urine it occasionally proves useful.

Potassii Acetas (Pot. Acet.).—Potassium Acetate; CH_3COOK .

Source.—Made by saturating acetic acid with potassium carbonate, evaporating and fusing. $\text{K}_2\text{CO}_3 + 2\text{CH}_3\text{COOH} = 2\text{CH}_3\text{COOK} + \text{H}_2\text{O} + \text{CO}_2$.

Characters.—White foliaceous satiny masses, or granular particles; very deliquescent; alkaline; taste saline, sharp. The peculiar appearance is due to crystallization after fusion. **Solubility.**—2 in 1 of water; 1 in 2 of alcohol 90 per cent. **Impurities.**—The carbonate, detected by being insoluble in spirit; excess of acid, giving acid reaction; other metals.

Doses.—Horses, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{iv}$.; cattle $\mathfrak{z}\text{iv}$.; sheep and pigs, $\mathfrak{z}\text{i}$.; dogs, grs. iv. to grs. xx.

ACTIONS AND USES.—Potassium acetate is an efficient saline diuretic, and does not markedly dilate the renal bloodvessels. It is employed as a diuretic in ascites and in renal affections.

Potassii Permanganas (Pot. Permang.).—Potassium Permanganate; KMnO_4 .

Source.—May be obtained by the action of carbon dioxide on an aqueous solution of potassium manganate.

Characters.—Dark purple, slender, iridescent prisms; inodorous, with a sweet astringent taste; yielding a rich purple solution when moistened. **Solubility.**—1 in 20 of water. Neutral. **Incompatible** with oxidizable matters, glycerin, alcohol, sugar, ammonium, alkaloids. **Impurities.**—Other metals; carbonates, chlorides, sulphates.

Liquor Potassii Permanganatis (not official).—1 part dissolved in 100 parts of distilled water; 1 gr. in 110 min.

ACTIONS AND USES.—*Externally*, potassium permanganate is a disinfectant, an antiseptic and a deodorant. It acts by parting with oxygen to albumin or other organic matter, but since it is rapidly deoxidized its action is very transient. A 1 per cent. solution is employed as a disinfectant; for wound irrigation, solutions ranging in strength from 1 in 1,000 to 1 in 500 are used.

In the treatment of snake-bite it is applied to the wound, either in the form of crystals or as a saturated solution after excising the bite.

Internally, it is an antidote to opium poisoning, as it has the power of oxidizing the alkaloid morphine. For this purpose it is more effectual when given in acidulated water.

DOSES.—Horses, 2 drachms; dogs, 10 to 15 grains.

Potassii Iodidum—Iodide of Potassium (see Iodine, p. 162).

Potassii Bromidum—Bromide of Potassium (see Bromine, p. 164).

Potassii Citras (Pot. Cit.)—Potassium Citrate; $C_3H_4 \cdot OH(COOK)_3 \cdot H_2O$.

Source.—Made by interaction of citric acid and potassium carbonate. $3K_2CO_3 + 2C_3H_4 \cdot OH \cdot (COOH)_3 = 2C_3H_4 \cdot OH \cdot (COOK)_3 + 3H_2O + 3CO_2$.

Characters.—A white granular powder; taste saline, feebly acid; deliquescent. **Solubility.**—1 in 1 of water.

Citrate of potassium is a saline diuretic, rendering the urine alkaline, and is occasionally employed in canine practice.

DOSE.—5 to 20 grains.

Potassii Tartras Acidus (Pot. Tart. Acid.)—Acid Potassium Tartrate; $(CHOH)_2 \cdot COOH \cdot COOK$; Purified Cream of Tartar.

Source.—Prepared from argol deposited in wine-casks during the fermentation of grape juice.

Characters.—A white gritty powder, or fragments of crystalline cakes; taste pleasant acid; not deliquescent. **Solubility.**—1 in 220 of cold water; not in alcohol. **Incompatible** with alkalies. **Impurities.**—Other metals; sulphates and chlorides.

Acid potassium tartrate is a mild saline cathartic and diuretic occasionally used in canine practice.

DOSE.—5 to 40 grains.

Potassa Sulphurata.—See Sulphur (p. 166).

SODIUM.

GENERAL ACTIONS OF SODIUM SALTS.—Sodium, itself, has no specific action, and the actions of its salts are due to their respective acid radicals.

Sodii Hydroxidum (Sod. Hydrox.).—Sodium Hydroxide; Caustic Soda; NaOH.

Source.—Electrolysis of sodium chloride.

Characters.—White rods or sticks, very deliquescent and very soluble.

ACTIONS.—Caustic soda has caustic, alkaline, and detergent actions similar to those of caustic potash.

Sodii Carbonas (Sod. Carb.).—Sodium Carbonate; $\text{Na}_2\text{CO}_3, 10\text{H}_2\text{O}$.

Source.—Made from sodium chloride by interaction with ammonium bicarbonate, subsequent ignition, and crystallization. (1) $\text{NH}_4\text{HCO}_3 + \text{NaCl} = \text{NaHCO}_3 + \text{NH}_4\text{Cl}$, and (2) $2\text{NaHCO}_3 = \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$.

Characters.—Transparent, colourless, rhombic crystals, efflorescent; taste and reaction strongly alkaline. *Solubility.*—1 in 2 of water; insoluble in alcohol. 20 parts neutralize 9.8 parts citric acid, or 10.5 parts tartaric acid. *Incompatible* with acid substances, heavy metals, alkaloidal salts. *Impurities.*—Chlorides, lead, arsenic.

Sodii Bicarbonas (Sod. Bicarb.).—Sodium Bicarbonate; NaHCO_3 .

Source.—Prepared by exposing the carbonate to carbon dioxide. $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 = 2\text{NaHCO}_3$, or by interaction of sodium chloride and ammonium bicarbonate.

Characters.—A white powder, or small opaque monoclinic crystals; taste saline. *Solubility.*—1 in 11 of water. 20 parts neutralize 16.7 parts of citric acid, or 17.8 parts of tartaric acid. *Incompatible* with acid substances, heavy metals, alkaloidal salts. *Impurities.*—Chlorides, sulphates, ammonium.

DOSES.—Horses, ʒii. to ʒss. ; cattle, ʒss. to ʒi. ; sheep and pigs, ʒss. to ʒi. ; dogs, grs. v. to grs. xx. It can be administered either in the form of powder or electuary, and is readily taken in the drinking water.

ACTIONS.—*Externally*, weak solutions of the carbonate are detergent and mildly sedative to the skin.

Internally, the carbonate and bicarbonate differ only as regards the degree of their action; and in consequence of the tendency of the carbonate to irritate mucous membranes, the bicarbonate is almost invariably prescribed. The bicarbonate is an antacid in the stomach, where, when given before feeds, it decreases the secretion of gastric juice. In hyperchlorhydria the administration of sodium bicarbonate tends to the formation of sodium chloride with the evolution of carbonic acid gas; the latter, however, stimulates further production of acid.

MEDICINAL USES.—In gastric indigestion the bicarbonate is largely employed, either alone or in combination with nuxvomica and carminatives. It corrects acidity, and neutralizes the organic acids which arise from fermentation of the gastric ingesta. It is also used in large doses in the treatment of conditions associated with acetonæmia (see p. 398).

As a gastric sedative it is prescribed in combination with

bismuth in gastric catarrh. As an antacid, it is useful in the treatment of excessive acidity of the stomach.

Sodium carbonate may be employed as a reflex emetic for the dog.

Sodii Chloridum (Sod. Chlor.).—Sodium Chloride; NaCl.

Source.—Native common salt, purified.

Characters.—Small white granular or transparent cubic crystals, free from moisture, with saline taste. *Solubility.*—1 in 3 of water.

Doses.—As a purgative: cattle, $\frac{3}{4}$ vi., with an equal amount of magnesium sulphate dissolved in 3 pints of water and 1 lb. of treacle; sheep, $\frac{3}{8}$ ss. to $\frac{1}{2}$ lss., with a similar amount of magnesium sulphate. As a stomachic and alterative, 2 or 3 ounces may be given to horses or cattle twice daily mixed in the food.

Liquor Sodii Chloridi Physiologicus (Liq. Sod. Chlorid. Physiol.).—Normal Saline Solution.

Sodium chloride, 9; distilled water to 1,000. For intravenous injection the solution must be sterile.

Injectio Sodii Chloridi et Acaciæ (Inj. Sod. Chlorid. et Acac.).—Gum Saline. A solution in distilled water containing 0.9 per cent. of sodium chloride and 6 per cent. of gum acacia.

ACTIONS.—*Externally*, sodium chloride is a powerful antiseptic in the form of hypertonic solutions. These contain 5 per cent. sodium chloride dissolved in water, with $\frac{1}{2}$ per cent. sodium citrate (see p. 177). The proportions are sometimes increased up to 10 and 1 per cent. respectively.

Internally, chloride of sodium promotes digestion and assimilation, and it is desirable that an adequate allowance of the agent should be constantly supplied to the domestic herbivora. In full doses sodium chloride is a saline cathartic for ruminants, even when given in the form of a concentrated solution; if given to horses in a concentrated form it may produce violent colic. In both cattle and horses the administration of full doses of sodium chloride with a large volume of water by the stomach tube is followed by a satisfactory purgative action. A concentration of 5 per cent. of sodium chloride in water appears to give the optimum effect. Toxic doses are irritant, and produce gastro-enteritis.

MEDICINAL USES.—*Externally*, sodium chloride combined with nitre and chloride of ammonium forms a refrigerating lotion.

A solution of 10 grains to each ounce of water is employed as a sedative lotion in irritable conditions of the skin in dogs.

Hypertonic solutions are employed in the method of wound treatment known as 'lymph lavage'. This method is particularly valuable in herbivora (see also p. 176).

Internally, in the form of rock-salt, this agent should be allowed to horses and cattle both in the mangers and on the pasture.

In the early stages of 'red-water' in cattle, a saline purgative frequently aborts the attack. Sodium chloride is commonly used for this purpose. In gastric derangements of cattle, small doses of sodium chloride administered in electuary prove useful, and by inducing thirst lead the patient to drink fluids freely. Sodium chloride is used in emergency as an emetic for the dog, 1 or 2 teaspoonfuls in 4 ounces of warm water with half a teaspoonful of mustard flour being given for this purpose.

In the treatment of surgical shock occurring during or after operations, and in severe hæmorrhage, intravenous injections of normal saline solution prove of great value. It has been found that the addition to the saline of a colloid substance such as gum acacia (6 per cent.) retards the diffusion of the fluid from the blood-stream. 'Gum saline' (Inj. Sod. Chlorid. et Acac.) has been found much superior to ordinary saline in the treatment of shock and collapse. Intravenous saline injections raise the blood-pressure, and in severe hæmorrhage supply fresh fluid to the circulation. They also exert a diuretic effect, and thus assist in the removal of effete products from the body.

In emergency normal saline solution may be prepared by dissolving 1 drachm of sodium chloride in each pint of boiled (sterilized) water. Some surgeons prefer a 'physiological saline solution,' which can be prepared with tablets, each containing the following:

Ry	Sod. Chlor.	..	..	..	grs. xxv.
	Sod. Sulph.	..	..	..	grs. 1½.
	Sod. Carb.	..	..	..	grs. 1½.
	Sod. Phosph.	..	..	..	gr. i.
	Pot. Chlor.	..	..	..	grs. i.ss.

Two of these dissolved in a pint of sterilized water form the required solution.

In urgent cases of severe hæmorrhage quantities of normal saline solution may be administered per rectum.

Sodii Sulphas (Sod. Sulph.).—Sodium Sulphate; $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$; Glauber's Salt.

Source.—Obtained by the interaction of sodium chloride with sulphuric acid.

Characters.—Colourless, transparent, monoclinic prisms, efflorescent; taste bitter, saline. *Solubility*.—1 in 3 of water; insoluble in alcohol 90 per cent.

Doses.—As a purgative for cattle, lb.ss. to lb.i.; sheep, ʒii. to ʒiv.; well diluted with water, and given with treacle. As an alterative and laxative for horses, ʒii. twice daily, dissolved in the drinking water; for dogs, grs. x. to ʒss.

Sodii Sulphas Exsiccatus (Sod. Sulph. Exsic.) (*not official*).—Exsiccated Sodium Sulphate; Anhydrous Sodium Sulphate; Na_2SO_4 .

Source.—May be prepared by drying sodium sulphate at 100°C . until it ceases to lose weight.

Characters.—A white powder which readily absorbs moisture. It should be stored in well-stoppered bottles; solubility 1 in 8 of water.

Doses.—One half those of sodium sulphate.

ACTIONS.—Sulphate of soda administered in full doses to ruminants is a saline purgative, resembling magnesium sulphate, but slower in its action. Formerly it was believed that its purgative action in the horse was uncertain, but recent clinical observations have shown that its cathartic action in the horse is regular and safe. There is no evidence that it directly stimulates the secretion of bile.

Small doses are excreted by the kidneys for the most part unchanged, and produce a slight diuretic effect.

MEDICINAL USES.—As a saline purgative, it was administered with magnesium sulphate to cattle, since it exerts an indirect cholagogue action. Lothian strongly recommends exsiccated sodium sulphate in doses of $\frac{3}{4}\text{x}$. administered by stomach tube as a purgative in the treatment of impactive colic in heavy draught horses, and is emphatic in regard to its value. In canine practice sulphate of soda is not a suitable agent, as it tends to produce gastric irritation and vomiting.

Sulphate of soda is an antidote to carbolic acid poisoning. In urgent cases a solution may be injected directly under the skin, or into the peritoneal cavity. The phenol unites with the sulphate, forming a non-poisonous sulpho-carbolate, which is excreted in the urine.

Sodium Hyposulphite (*not official*).—Sodium Thiosulphate; $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$.

Prepared by passing sulphurous acid gas into a solution of carbonate of soda with sulphur.

Characters.—Occurs in the form of large transparent prisms, readily soluble in water. Insoluble in alcohol.

Doses.—Horses and cattle, $\frac{3}{4}\text{ss}$. to $\frac{3}{4}\text{i}$.; dogs, grs. v. to grs. x. Administered twice daily, either in the form of powder or mixture.

A solution composed of 10 grains of sodium hyposulphite dissolved in 1 ounce of distilled water is occasionally used in canine practice as an antiseptic and mildly stimulating collyrium.

Hyposulphite of soda is occasionally prescribed in the belief that it is an intestinal antiseptic, but it has not proved satisfactory for this purpose.

Sodii Phosphas Acidus (Sod. Phosph. Acid.).—Sodium Acid Phosphate; NaH_2PO_4 .

Source.—Obtained by the interaction of sodium phosphate with phosphoric acid.

Characters.—Transparent, colourless, rhombic crystals or crystalline powder; taste saline, acid. *Solubility*.—1 in 1 of water.

Dose.—Dogs, grs. x. to grs. xl.

Sodium acid phosphate, when administered by the mouth, renders the urine acid. It is therefore employed in the treatment of excessive alkalinity of the urine, and is used in conjunction with hexamine (see p. 206).

Sodii Biboras—Borax (see p. 173).

Sodii Bromidum (see p. 165).

Sodii Iodidum (see p. 163).

Sodii Salicylas (see p. 331).

Sodii Hypophosphis (see p. 160).

Sodii Cacodylas (see p. 1, 5).

Sodii Nitris (see p. 214).

AMMONIUM.

Liquor Ammoniae Fortis (Liq. Ammon. Fort.).—Strong Solution of Ammonia; NH_3 , 32.5 per cent. by weight, dissolved in water.

Source.—Made by heating ammonium chloride with slaked lime, and collecting the gaseous product in distilled water. $2\text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 = 2\text{NH}_3 + \text{CaCl}_2 + 2\text{H}_2\text{O}$.

Characters.—A colourless liquid with a very pungent characteristic odour, and strong alkaline reaction; Sp. gr. 0.888. *Incompatible* with acid substances, heavy metallic salts, alkaloids. *Impurities*.—Ammonium chloride, sulphide and sulphate; lime; other metals; tarry matters.

Liquor Ammoniae Dilutus (Liq. Ammon. Dil.).—Solution of Ammonia; NH_3 (10 per cent.) dissolved in water.

Source.—Strong solution of ammonia, 1; distilled water, 2.

Characters.—Clear liquid; odour and taste pungent. Sp. gr. 0.959. *Incompatible* with acid substances, heavy metallic salts, alkaloids.

Doses.—Horses, ʒii. to ʒss.; cattle, ʒss. to ʒi.; sheep and pigs, ʒi.; dogs, ʒv. to ʒx. Repeated at intervals according to circumstances, and administered *well diluted* with cold mucilaginous fluids or oil, to avoid its irritating effect on the mouth and pharynx.

GENERAL ACTIONS.—*Externally*, liquor ammoniae fortis possesses the typical actions of ammonia. If applied to the skin it is a stimulant; and if the application be prolonged, and evaporation prevented, it produces vesication. It should not be administered internally, for unless very freely diluted it causes violent irritation of the mouth, tongue, pharynx, and stomach.

Internally, inhaled by the nostrils, ammonia produces reflex stimulation of the vasomotor system, contraction of the splanchnic vessels, and a rise of blood-pressure, thus being a general stimulant. If administered *per os*, it is also a powerful reflex general stimu-

lant, acting on the heart, the cerebrum, the nerve centres, and the spinal cord; but its action in this respect is transient.

It is quickly absorbed and rapidly excreted.

TOXIC ACTIONS.—Toxic doses are irritant to the stomach, and, after primary stimulation of the nervous system, they cause paralysis of the nerve centres and spinal cord.

Errors have occurred in administering the strong solution of ammonia instead of the medicinal preparation.

ANTIDOTES.—Dilute acetic acid, vinegar, oil, and a free allowance of demulcents and diluents.

The irritating effects of this agent on the tongue and buccal membrane are best treated by keeping the animal on fluid diet, and applying mouth-washes containing dilute acetic acid, borax, and honey.

MEDICINAL USES.—*Externally*, the strong solution of ammonia is largely used as a component of stimulating liniments and as a mild counter-irritant. For these purposes, 1 part each of strong solution of ammonia, oil of turpentine, and water, are mixed with 10 parts of linseed-oil. Another useful liniment is prepared by mixing 1 ounce of camphor, 4 ounces of rectified spirit, 2 ounces of solution of ammonia, and 1 pint of olive-oil. Strong applications of ammonia should not be applied as counter-irritants, in consequence of their tendency to blemish the skin.

A weak solution of ammonia relieves the irritation produced by the bites and stings of insects.

Internally, the strong solution of ammonia is not used medicinally. The medicinal solution is employed as a general diffusible stimulant. In tympanites of the rumen in cattle it acts as an antacid, stimulates the action of the stomach and intestines, and aids in the expulsion of gas. It is also prescribed in spasmodic colic in the horse.

In canine practice the vapour of the strong solution of ammonia is sometimes employed as an inhalation in shock, and in narcotic poisoning, but its value is doubtful.

Ammonii Carbonas (Ammon. Carb.).—Ammonium Carbonate; Sal Volatile.

Source.—Made by subliming a mixture of ammonium chloride (or sulphate) and calcium carbonate. (1) $2\text{NH}_4\text{Cl} + \text{CaCO}_3 = (\text{NH}_4)_2\text{CO}_3 + \text{CaCl}_2$. (2) $2(\text{NH}_4)_2\text{CO}_3 = \text{NH}_4\text{HCO}_3 + \text{NH}_4\text{NH}_2\text{CO}_2 + \text{NH}_3 + \text{H}_2\text{O}$. (3) $\text{NH}_4\text{HCO}_3 + \text{NH}_4\text{NH}_2\text{CO}_2 = \text{N}_3\text{H}_{11}\text{C}_2\text{O}_5$. This salt is considered to be a mixture of ammonium hydrogen carbonate (NH_4HCO_3) with ammonium carbamate ($\text{NH}_4\text{NH}_2\text{CO}_2$).

Characters.—Translucent crystalline masses, efflorescent, volatile and pungent to the nose; alkaline. **Solubility.**—1 in 4 of water. 20 parts neutralize $26\frac{2}{3}$ parts citric acid, or $28\frac{2}{3}$ parts tartaric acid. **Incompatible** with acid substances, caustic alkalies, lime-water,

metallic salts, alkaloids. *Impurities*.—Sulphates and chlorides; tarry matters.

Doses.—Horses, \mathfrak{z} i. to \mathfrak{z} ss.; cattle, \mathfrak{z} ss. to \mathfrak{z} i.; sheep and pigs, grs. xv. to gr. xxx.; dogs, grs. iii. to grs. viii. Administered in the form of bolus or pill, or dissolved in cold mucilaginous solution, and repeated at intervals according to circumstances.

ACTIONS.—Carbonate of ammonia, although not so active as the solution of ammonia, is less transient in its effects. It is a powerful reflex general stimulant in full doses, acting on the cardiac and respiratory systems, and also on gland secretion. It promotes gastric and intestinal secretion, and by stimulating the vagus nerve-endings in the stomach it reflexly induces an increased and more fluid secretion from the bronchial mucous membrane; so acting as an expectorant. It is antacid, antitympa-
nitic, and carminative.

MEDICINAL USES.—Carbonate of ammonia is a useful agent in the treatment of respiratory affections when stimulants are indicated; it is preferable to alcohol for this purpose and can be administered in bolus, repeated at intervals.

In the treatment of obstructive colic, depending on impaction of the large intestine, full doses of carbonate of ammonia, combined with nux vomica, are employed. Caulton Reeks advises the administration of 2 ounces of carbonate of ammonia and 1 ounce of powdered nux vomica, divided into four balls, and given at one dose. This dose is intended for a heavy draught horse, and can be reduced in the case of an animal of smaller size. The carbonate of ammonia alone is repeated at intervals according to the progress of the case. By means of this treatment it is claimed that tone is restored to the intestinal walls, normal peristaltic action is promoted, and a general stimulant and antispasmodic effect is elicited.

In gastric atony of cattle carbonate of ammonia is largely used, in combination with nux vomica. It relieves tympany, restores tone to the gastric walls, and acts as a general stimulant.

In canine practice carbonate of ammonia, combined with the tincture of ipecacuanha, is sometimes prescribed as an emetic in cases of bronchitis, in which it is desirable to remove viscid mucus from the bronchial tubes. The expiratory efforts induced by the act of vomiting cause expulsion of material obstructing the respiratory passages; apomorphine is, however, preferable for this purpose.

As an expectorant, promoting bronchial secretion and expectoration, it is prescribed in the secondary stages of bronchitis.

Spiritus Ammoniae Aromaticus (Sp. Ammon. Aromat.).—Aromatic Spirit of Ammonia; Spirit of Sal Volatile; Strong Solution of Am-

monia, 200; Ammonium Carbonate, 100; Oil of Nutmeg; Oil of Lemon; Alcohol, 90 per cent., 3,000; Water to 4,000.

Characters.—A colourless liquid with pungent odour and taste. Sp. gr., 0.888 to 0.893.

Doses.—Horses and cattle, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$.; dogs, $\mathfrak{M}\text{xx}$. to $\mathfrak{z}\text{i}$.

ACTIONS AND USES.—As this preparation contains about $\frac{1}{2}$ ounce of carbonate of ammonia and 1 ounce of strong solution of ammonia to the pint, it is not of sufficient strength for horses and cattle unless given in large doses. To prevent irritation of the mouth it must be well diluted, and as the preparation is expensive as compared with the carbonate of ammonia, the latter is usually preferred for the larger animals.

In canine practice aromatic spirits of ammonia is employed as a general stimulant, and as a carminative and antacid. In combination with vegetable bitters, such as calumba or gentian, it forms a useful alkaline stomachic mixture in dyspepsia.

Liquor Ammonii Acetatis Fortis (Liq. Ammon. Acet. Fort.).—Strong Solution of Ammonium Acetate.

Prepared by dissolving ammonium carbonate in a mixture of glacial acetic acid and water, and neutralizing the solution with strong solution of ammonia. Contains 57.5 per cent. of ammonium acetate.

Characters.—A thin, syrupy liquid with an odour of ammonia and of acetic acid.

Doses.—Horses, $\mathfrak{z}\text{iv}$. to $\mathfrak{z}\text{vi}$.; dogs, $\mathfrak{M}\text{xv}$. to $\mathfrak{z}\text{ss}$.

Liquor Ammonii Acetatis Dilutus (Liq. Ammon. Acet. Dil.).—Solution of Ammonium Acetate. 'Mindererus' Spirit.

Prepared by diluting strong solution of ammonium acetate with distilled water, 1 in 8.

Incompatibles.—Potash, soda, and other carbonates; acids; lime water; spirit of nitrous ether; salts of lead and silver. Should be preserved in lead-free glass bottles.

Doses.—Horses, $\mathfrak{z}\text{iv}$. to $\mathfrak{z}\text{vi}$.; dogs, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{ss}$.

ACTIONS AND USES.—Acetate of ammonium is a diaphoretic, a febrifuge, and a mild diuretic. Its diaphoretic action is not well marked in animals, and, in consequence of the relatively small amount of ammonia this preparation contains, its action as a stimulant is very slight. In combination with sweet spirit of nitre, acetate of ammonia constitutes an old form of febrifuge mixture; these substances are, however, chemically incompatible, and when first mixed gas is evolved.

Ammonii Chloridum (Ammon. Chlorid.).—Ammonium Chloride; NH_4Cl ; Sal Ammoniac.

Source.—Made by neutralizing crude solution of ammonia or ammonium carbonate with hydrochloric acid; evaporating to dryness; and purifying by sublimation. $\text{NH}_4\text{OH} + \text{HCl} = \text{NH}_4\text{Cl} + \text{H}_2\text{O}$.

Characters.—Colourless crystals; inodorous; taste saline, cooling. *Solubility*.—1 in 3 of water; 1 in 60 of alcohol 90 per cent. Volatilizes with heat. *Incompatible* with alkalies and their carbonates,

mineral acids, lead, and silver salts. *Impurities*.—Iron, lead, and other metals; carbonates, nitrates, and sulphates.

Doses.—Horses, ʒii. ; cattle, ʒss. ; sheep and pigs, grs. xx. to ʒss. ; dogs, grs. iii. to grs. x.

ACTIONS AND USES.—*Externally*, in combination with nitrate of potassium, sodium chloride, and water, it forms a refrigerating lotion (see also p. III.).

Internally, chloride of ammonium is an expectorant, acting in the same manner as the carbonate. In toxic doses it is a gastro-intestinal irritant. It is occasionally prescribed in the secondary stages of acute bronchitis, and in chronic bronchitis.

CALCIUM.

Calx.—Lime; Calcium Oxide; CaO (*not official*).

Source.—By calcining marble. $\text{CaCO}_3 = \text{CaO} + \text{CO}_2$.

Characters.—Compact whitish masses, which readily absorb water, swell, and fall to powder (slaking), with development of much heat.

Calcii Hydroxidum (*Calc. Hydrox.*).—Calcium Hydroxide; Slaked Lime; Ca(OH)_2 .

Source.—Recently made by slaking calcium oxide with water. $\text{CaO} + \text{H}_2\text{O} = \text{Ca(OH)}_2$.

Characters.—A white powder, strongly alkaline, soluble in cold water (1 in 900); more so with sugar (1 in 60). *Incompatible* with vegetable and mineral acids and metallic salts.

Liquor Calcii Hydroxidi (*Liq. Calc. Hydrox.*).—Solution of Lime; Lime Water. Made by shaking up Calcium Hydroxide (previously washed in water to free it from chlorides) in Distilled Water, and decanting. 0.1 g. of Lime in 100 ml., or $\frac{1}{10}$ gr. in 110 min.

Solution of Lime is used in preparing Lotio Hydrargyri Flava and Lotio Hydrargyri Nigra.

Linimentum Calcis (*not official*).—Liniment of Lime; Lime-water and Olive Oil, equal parts, shaken together.

‘CARRON-OIL’ (*not official*)—

PREPARED by mixing equal parts of lime-water and linseed-oil.

Liquor Calcis Saccharatus (*not official*).—Saccharated Solution of Lime. By digesting Calcium Hydroxide 5 and Sugar 10 in Water 100; and decanting. Contains 2 per cent. by weight of CaO , or 2 grains of Lime in 110 min.

Doses.—Calves, ʒii. ; dogs, ʒxx. to ʒi.

ACTIONS AND USES.—*Externally*, lime is a caustic and irritant. It is largely employed in the form of a watery suspension as a cleansing and disinfectant wash (‘lime wash’) to the walls of buildings, etc.

Liniment of lime and carron-oil are employed as local applications to scalds and burns.

Internally, lime-water possesses sedative, antacid, and astringent actions. It is frequently added to milk, in order to prevent

the formation of masses of casein in the stomachs of young animals fed exclusively on this diet. The addition of about one-fourth of lime-water proves very beneficial in such cases.

In irritable conditions of the stomach met with in dogs, and characterized by excessive acidity and frequent vomiting, lime-water added to the milk diet proves beneficial.

Creta (Cret.).—Prepared Chalk; Native Calcium Carbonate freed from most of its impurities by elutriation.

Characters.—White friable masses or a white powder. *Incompatible* with all acids and sulphates. *Impurities.*—Metals; phosphates, sulphates, silica.

Doses.—Horses, \mathfrak{z} i. to \mathfrak{z} ii.; cattle, \mathfrak{z} ii. to \mathfrak{z} iv.; sheep and pigs, \mathfrak{z} ii. to \mathfrak{z} iv.; dogs, grs. viii. to \mathfrak{z} ss.

Mistura Cretæ (not official).—Chalk Mixture; Prepared Chalk, 3; Tragacanth, 0.5; Refined Sugar, 6; Cinnamon Water to 100.

Dose.—Dogs, \mathfrak{z} i. to \mathfrak{z} vi.

ACTIONS AND USES.—Chalk is antacid and astringent. Being even more slowly absorbed than lime-water, it exerts its actions wholly on the intestinal canal. It is prescribed in diarrhoea, in which condition it produces its beneficial effects by lessening the irritability of the intestinal mucous membrane, upon which a protective film of calcium carbonate is deposited.

In severe diarrhoea it is combined with astringents and carminatives such as chlorodyne, and may be administered as a suspension in starch mucilage. Astringents in such cases should be used with discretion.

Chalk is an antidote to oxalic acid and the mineral acids.

Calx Chlorinata (Calx Chlorinat.).—Chlorinated Lime; Bleaching Powder; CaCl_2O_2 , CaCl_2 , or CaOCl_2 . A compound of Calcium Hypochlorite and Calcium Chloride, or directly of Lime and Chlorine.

Source.—Made by passing Cl gas over slaked lime until absorption ceases. $2\text{Ca}(\text{OH})_2 + 2\text{Cl}_2 = \text{CaCl}_2\text{O}_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$.

Characters.—A dull-white powder; odour chlorinous. Becomes moist and decomposes on exposure to air. Partially soluble in water. Bleaches and disinfects. Contains not less than 30 per cent. available chlorine. *Impurity.*—Deficiency in chlorine, detected volumetrically with sodium thiosulphate.

ACTIONS AND USES.—It is a disinfectant and deodorizer, and may be employed for disinfecting animal houses; but other agents are preferable for this purpose.

For preparations of Calx Chlorinata, see p. 161.

Calcii Sulphas.—Sulphate of Lime; Calcined Gypsum; Plaster of Paris (*not official*).

This agent is employed in making plaster of Paris bandages for use in the treatment of fractures.

Calcii Phosphas (Calc. Phosphas).—Calcium Phosphate; $\text{Ca}_3(\text{PO}_4)_2$.

Source.—Made by the interaction of calcium chloride with sodium phosphate and excess of ammonia at a boiling temperature. $3\text{CaCl}_2 + 2\text{Na}_2\text{HPO}_4 + 2\text{NH}_4\text{OH} = \text{Ca}_3(\text{PO}_4)_2 + 4\text{NaCl} + 2\text{NH}_4\text{Cl} + 2\text{H}_2\text{O}$.

Characters.—A light white amorphous powder, insoluble in water.

Phosphate of Lime in the form of the **SYRUPUS CALCII LACTO-PHOSPHATIS** (omitted from B.P. 1932) is occasionally prescribed in the treatment of anæmia and rickets in young animals.

Dose.—Calves and foals, \mathfrak{zss} . to \mathfrak{zii} .; dogs, \mathfrak{Mx} . to \mathfrak{Mxxx} . (see Phosphorus, p. 160).

Calcii Hypophosphis (*not official*). (See Phosphorus, p. 160.)

Calcii Gluconas (Calc. Glucon.).—Calcium Gluconate ($\text{C}_6\text{H}_{11}\text{O}_7$) $_2\text{Ca}$.

Source.—A neutral organic salt prepared from calcium and gluconic acid.

Characters.—A fine white crystalline substance. *Solubility*.—1 in 30 of water.

Doses.—Mares, \mathfrak{zii} . to \mathfrak{ziii} .; cows, \mathfrak{zii} . to $\mathfrak{ziii.ss}$.; ewes, \mathfrak{zii} . to \mathfrak{zss} .; sows, \mathfrak{ziii} . to \mathfrak{zss} .; bitches, grs. xv. to grs. l.

Calcium gluconate elicits specific curative response in milk fever and allied acute hypocalcæmic conditions. It is very distinctly preferable to the chloride and lactate in that it may be injected subcutaneously and intramuscularly. Its solubility can be markedly increased by the addition of boric acid, with which it forms a compound to which the formula $\text{Ca}(\text{C}_6\text{H}_9\text{O}_2.\text{BOH})_2$ has been provisionally assigned; this compound is known as **CALCIUM BORO-GLUCONATE** (soluble 1 in 1 of water).

In the treatment of milk fever 2 to 3½ ounces of calcium gluconate are mixed with 3 drachms of boric acid and dissolved in 12 ounces of hot water. The solution is injected intravenously or preferably subcutaneously at one or more points (see p. 464; see also Thymol, p. 284).

Calcium gluconate is considered to be an antidote to the toxic effects of carbon tetrachloride.

Calcii Chloridum (Calc. Chlorid.).—Calcium Chloride; CaCl_2 .

Source.—Made by neutralizing hydrochloric acid with calcium carbonate, and desiccating.

Characters.—White, very deliquescent masses, with bitter acid taste. *Solubility*.—1 in 1.5 of water; 1 in 3 of alcohol 90 per cent. *Incompatible* with carbonates, phosphates, tartrates, and sulphates. *Impurities*.—Carbonates; salts of aluminium and iron; hypochlorites.

Calcii Lactas (Calc. Lact.).—Calcium Lactate; $\text{Ca}(\text{COO}.\text{CHOH}.\text{CH}_3)_2$, $5\text{H}_2\text{O}$.

Source.—By neutralizing dilute lactic acid with calcium carbonate, and evaporating the resulting solution.

Characters.—A white powder; almost tasteless. *Solubility*.—1 in 18.5 of water.

Calcium chloride and calcium lactate have also been applied with specific curative effect in the treatment of acute parturient hypocalcæmia (milk fever) in cows. Of calcium chloride ʒi. to ʒi.ss. (in 10 per cent. solution) is injected intravenously (but see p. 464).

MAGNESIUM.

Magnesii Carbonas Ponderosus (Mag. Carb. Pond.).—Heavy Magnesium Carbonate; $3(\text{MgCO}_3), \text{Mg}(\text{OH})_2, 4\text{H}_2\text{O}$.

Source.—By mixing *strong boiling* solutions of magnesium sulphate and sodium carbonate, evaporating to dryness, digesting residue with water, filtering, washing free from sulphates, and drying. $4\text{MgSO}_4 + 4\text{Na}_2\text{CO}_3 + 5\text{H}_2\text{O} = 3(\text{MgCO}_3), \text{Mg}(\text{OH})_2, 4\text{H}_2\text{O} + 4\text{Na}_2\text{SO}_4 + \text{CO}_2$.

Characters.—A white granular powder, comparatively insoluble in water. *Incompatible* with acid substances.

Magnesii Carbonas Levis (Mag. Carb. Lev.).—Light Magnesium Carbonate; $3(\text{MgCO}_3), \text{Mg}(\text{OH})_2, 4\text{H}_2\text{O}$.

Source.—Made like *magnesii carbonas ponderosus*, but with *cold dilute* solutions; boiling for 15 minutes; filtering, washing, and drying.

Characters.—A very light white powder, proving microscopically to be partly amorphous, with prismatic crystals. Three and a half times the bulk of the heavy carbonate.

Magnesii Oxidum Ponderosum (Mag. Oxid. Pond.).—Heavy Magnesia; Heavy Calcined Magnesia; MgO .

Source.—Exposing heavy carbonate to dull-red heat.

Characters.—A white powder, insoluble in water.

Magnesii Oxidum Leve (Mag. Oxid. Lev.).—Light Magnesia; Light Calcined Magnesia; MgO .

Source.—Made by exposing light magnesium carbonate to a dull-red heat.

Characters.—A white, very light powder, $3\frac{1}{2}$ times the bulk of heavy magnesia; sparingly soluble in water.

DOSES OF CARBONATES AND OXIDES.—Foals and calves, aged from three to four months, ʒss. to ʒiii. ; dogs, grs. v. to ʒss.

ACTIONS AND USES.—The carbonates and oxides of magnesia are chiefly prescribed as antacids and laxatives for young foals, calves, and for dogs.

A mixture of the carbonate with the sulphate of magnesium is useful in canine practice, forming the 'Mistura Alba.' This is prepared by combining 15 grains of magnesium carbonate and 30 grains of magnesium sulphate in 1 ounce of water. Dose, ʒii. to ʒi.

Magnesii Sulphas (Mag. Sulph.).—Magnesium Sulphate; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$; Epsom Salt.

Source.—Made from native magnesium carbonates, by interaction with diluted sulphuric acid; or by purifying the native sulphate.

Characters.—Small colourless rhombic prisms, with a bitter taste. *Solubility*.—1 in 1 of water. *Incompatible* with alkali carbonates

and bicarbonates; strong solutions with bromides. *Impurities*.—Other metals; nitrates.

Doses.—As a purgative: for adult cattle, ʒviii. to ʒxii. ; calves, two or three months, ʒiii. to ʒiv. ; sheep and pigs, ʒiii. ; dogs, ʒi. to ʒiii. As an alterative and febrifuge: horses, ʒii. to ʒiii. , repeated twice daily, and administered either in the food or in the drinking water; dogs, grs. x. to grs. xx.

ACTIONS.—Magnesium sulphate is a saline purgative, and when given to ruminants in full doses is a hydragogue cathartic, causing in from twelve to fifteen hours free fluid evacuations. Only a small portion of the drug is absorbed, and this is excreted by the kidneys. A considerable amount of fluid is removed from the blood; as a result a compensating amount is withdrawn from the tissues, and thirst is induced. Solutions containing less than 5 per cent. of the drug may fail to induce purgation. Sulphate of magnesium is an indirect cholagogue. The purgative action of sulphate of magnesium on the horse is uncertain, but small doses frequently repeated produce a gentle aperient effect. In the dog a full dose is more likely to induce vomiting than purgation, but small doses are laxative.

MEDICINAL USES.—*Externally*, a saturated solution of magnesium sulphate proves useful as an application to strains and to inflamed joints. The application of hot saturated solutions to inflamed and infected tissue has an anodyne effect due to the sedative action of the drug on the sensory nerve endings, and in addition the powerful osmotic action which is induced is of considerable value in combating septic inflammatory processes.

Internally, as a purgative the sulphate of magnesium is largely employed for ruminants, and if used with discretion is a very valuable agent for this purpose. It should be administered in warm water and treacle, the addition of a carminative such as powdered ginger being of advantage in preventing griping.

Large repeated doses of magnesium sulphate are contra-indicated in obstinate constipation in cattle associated with atony of the gastric and intestinal walls. In such a condition magnesium sulphate seldom succeeds in effecting catharsis.

A combination of equal quantities of magnesium sulphate and sodium chloride produces more active cathartic effects than does the magnesium salt when administered alone, but violent purgation is very seldom desirable.

For the horse, sulphate of magnesium, although not prescribed as an active cathartic, is useful as a mild aperient. It is readily taken in the food or in the drinking water; 2-ounce doses can be

administered in this manner, and repeated until mild purgation results.

In febrile conditions sulphate of magnesium is largely prescribed. It lowers abnormal temperature by stimulating the functions of the bowels and kidneys, and so assisting in the removal of effete products from the body. For these purposes it is combined with nitrate of potassium, and may be given dissolved in the patient's drinking water twice daily. It is also prescribed as an alterative.

In the treatment of tetanus, subcutaneous injections of solutions of sulphate of magnesia have been found beneficial in controlling the muscular spasms.

In canine practice it is not employed as a purgative, as it frequently nauseates the patient. Small doses, however, are prescribed as alteratives and laxatives.

Sulphate of magnesium is an antidote in poisoning by salts of lead. It converts these into insoluble sulphates, and assists in their removal. It is also an antidote to poisoning by carbolic acid, which it converts into non-toxic sulphocarbulates.

Magnesium salts are injected parenterally in the treatment of diseases associated with acute hypo-magnesæmia. For this purpose the chloride may be given intravenously or the sulphate subcutaneously, a suitable dose for adult cattle being 2 to 4 drachms (p. 468).

BARIUM.

Barii Chloridum.— $\text{BaCl}_2, 2\text{H}_2\text{O}$ (*not official*).

Characters.—Colourless translucent plates. *Solubility.*—1 in 2.5 of water.

Dose.—As an intravenous injection for the horse, grs. viii. to grs. xx., dissolved in $2\frac{1}{2}$ to 6 drachms of water. As a draught, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{ii}$. in 2 pints of water.

ACTIONS.—Barium chloride directly stimulates plain muscle. Administered by intravenous injection, it acts with great rapidity. Within one to two minutes it causes energetic contraction of the muscular coat of the intestine throughout its entire length, and copious evacuations. This action may continue for five or six hours. Like digitalis, it renders the cardiac contractions slower and stronger. The bloodvessels and bronchioles are constricted by direct action upon their muscular coats. The muscles of the bladder and uterus are also powerfully contracted.

While the heart is at first stimulated and blood-pressure raised, the cardiac action is later depressed and blood-pressure falls.

TOXIC ACTIONS.—In toxic doses barium chloride produces salivation, muscular tremors, sweating, violent straining, and

finally spasm of the heart and general paralysis of the nervous system.

ANTIDOTE.—Sulphate of magnesium or sulphate of sodium, both of which convert the chloride into the insoluble sulphate.

MEDICINAL USES.—Chloride of barium has been employed in the treatment of colic in the horse depending on impaction of the intestine, but the violence of its action, the difficulty in controlling its action, the risks of rupture of the intestine, or of fatal cardiac depression, should lead to the choice of agents which experience has proved to be safer and quite as effectual.

For intravenous injection Dieckerhoff recommends that the dose be divided as follows: Half the amount at the first injection, and two quarter-doses at intervals of eight to ten minutes. Administered as a draught, the chloride of barium is not so certain in its effects.

Chloride of barium has also been recommended in the treatment of impaction of the rumen and acute tympanites in cattle. The doses advised are: for cows \bar{z} iv., and for oxen and bulls \bar{z} v. These doses are divided into two parts, and may be given, in combination with sodium chloride, in draught, electuary, or bolus, an interval of three or four hours being allowed between each dose.

Barii Sulphas (Barii Sulphas).—Barium Sulphate.

Source.—Barium sulphate may be prepared by the interaction of a soluble barium salt and a soluble sulphate.

Characters.—A heavy white amorphous powder; odourless, tasteless.

Barium sulphate is used in small animal practice to provide an opaque medium for the radiographic study of the alimentary canal.

GROUP II—THE METALS.

ALUMINIUM.

This metal is used in the form of **Alumen** or **Alum**.

Alumen (Alum).—Alum; Aluminium and Potassium Sulphate (Potassium Alum), $\text{Al}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$; or Aluminium and Ammonium Sulphate (Ammonium Alum), $\text{Al}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$.

Source.—Produced by the combination of aluminium sulphate with potassium sulphate or with ammonium sulphate.

Characters.—Colourless transparent octahedra, with a sweetish, astringent taste. **Solubility.**—1 in 10 of water (solution acid); freely in glycerin; insoluble in alcohol 90 per cent. **Incompatible** with alkalies, lime, lead, tartrates, tannic acid, mercury, and iron. **Impurities.**—Other metals.

Glycerinum Aluminis.—Potassium Alum 20, triturated with Distilled Water 7·5, and Glycerin up to 120 with gentle heat.

Alumen Exsiccatum.—Exsiccated Alum (*not official*).

Source.—Made by heating *Potassium Alum* till aqueous vapours cease to be disengaged, and about 45 per cent. of weight is lost.

Characters.—A white powder. *Solubility.*—1 in 20 of water. It absorbs moisture when exposed to air.

ACTIONS AND USES.—*Externally* alum coagulates albumin and possesses astringent and styptic actions.

The glycerinum aluminis diluted with water is employed as a mouth-wash in ulcerative stomatitis.

A saturated solution of alum proves useful as a styptic. It is also a popular application to the shoulders of horses which have a tendency to become galled by the collar.

A solution containing 1 drachm of alum to the pint of water has been found useful as an injection in leucorrhœa.

Internally, alum is an astringent, and in carnivora an emetic. In toxic doses it is an irritant to the gastro-intestinal canal.

Alum is often administered to cows in order to arrest the secretion of milk when it is desired to stall-feed the animals, the dose being from 2 to 4 drachms twice daily.

Alum is an antidote to lead-poisoning; it precipitates the lead as the insoluble sulphate.

Kaolinum (Kaolin).—Kaolin. A native Aluminium Silicate, powdered, and freed from gritty particles by elutriation.

Characters.—A soft whitish powder, insoluble in water or in diluted acids.

Cataplasma Kaolini (Catapasm. Kaolin).—Poultice of Kaolin. Kaolin, 527; boric acid, 45; methyl salicylate, 2; oil of peppermint, 0·5; thymol, 0·5; glycerin, 425.

Kaolin has astringent properties, and is used as a dusting powder. Kaolin poultice is now employed as the most convenient means of applying moist heat to any part of the body. In addition to its properties of retaining heat for a considerable period of time, the poultice possesses valuable antiseptic and osmotic properties.

Kaolin, in 1 ounce doses, is employed as an intestinal astringent in cattle practice. It has no direct antiseptic action, but is capable of adsorbing bacterial toxins.

PLUMBUM.

GENERAL ACTIONS OF LEAD SALTS.—*Externally*, the salts of lead are astringent, sedative, and desiccant. They precipitate albumin, cause contraction of capillaries, and depress the peripheral terminations of sensory nerves. In the last action they differ from most of the other metals.

Internally they act as astringents, diminishing secretion and

contracting bloodvessels. Lead salts are absorbed as albuminates, and are readily taken up by the tissues from which they are slowly excreted by the bowels, kidneys, liver, and skin.

TOXIC ACTIONS.—Lead is a cumulative poison, and the repeated ingestion of small quantities of lead over a prolonged period results in chronic lead-poisoning or plumbism.

The symptoms of plumbism vary in different animals; in some there is evidence of gastro-intestinal disturbance; in others a peripheral neuritis occurs, resulting in a cramped condition of the muscles of the limbs, and finally paralysis, especially of the extensor groups of muscles.

In veterinary practice, cattle are the most common subjects of lead-poisoning; in these animals the toxic symptoms are, almost invariably, of an acute type.

In cattle, cerebral symptoms, evidenced by a staggering gait and impaired vision, occur.

In horses, convulsions, partial paralysis, and marked respiratory distress have been observed.

Colic and constipation, which are frequent symptoms of lead-poisoning in man, are seldom met with in animals.

The condition known as 'roaring,' which results from degeneration of the recurrent laryngeal nerve, is commonly associated with plumbism in the horse.

The clinical diagnosis of lead-poisoning is difficult, as the symptoms may be ascribed to other causes. In plumbism a blue line may be observed around the gums at the base of the incisor teeth. This is due to a deposition of the sulphide of lead beneath the mucous membrane.

Poisoning may result from contamination of the food or water with lead. In numerous instances toxic symptoms have been produced by animals licking fresh paint containing lead.

Other sources of lead-poisoning are found in the contamination of pastures situated near smelting furnaces, and in bullet spray from rifle butts.

Soft waters and those rich in nitrites, nitrates, chlorides, and nitrogenous matters, may acquire toxic properties by passing through lead pipes, especially if these be new.

Hard waters—*i.e.*, those containing carbonates, sulphates, or phosphates—are less liable to contamination, as insoluble precipitates are formed in the pipes, and the water cannot come into contact with the metallic lead.

ANTIDOTES.—The antidotes to acute lead poisoning are soluble sulphates, such as those of sodium and magnesium, and dilute sulphuric acid, the lead being precipitated as an insoluble sulphate. In plumbism or chronic lead poisoning iodide of

potassium is administered three times daily, each dose being followed in about two hours by sulphate of magnesia and dilute sulphuric acid.

It is believed that the iodide of potassium eliminates the lead from the tissues into the blood (the albuminate of lead being soluble in solutions of potassium iodide); it is then removed by the intestinal canal. Here the sulphate of magnesia converts the lead into the insoluble sulphate, and its aperient action hastens the evacuation of the lead from the bowel.

The metabolism of lead resembles that of calcium in that the lead is deposited in the bones from which it is slowly released. The most effective treatment for plumbism consists in increasing the excretion of calcium by giving repeated doses by mouth of a readily assimilable calcium salt and hypodermic injections of parathyroid extract. By thus causing an increased transference of calcium and lead from the bones to the blood, the elimination of lead is facilitated.

In the case of plumbism resulting from water passing through lead pipes, the taps should be allowed to flow for a time before the animals are watered.

Plumbi Monoxidum (Plumb. Monox.).—Lead Oxide; PbO; Litharge.

Source.—Made by the action of air on melted lead.

Characters.—Heavy scales of a pale yellowish-red colour. Soluble in diluted nitric acid and in acetic acid; insoluble in water. *Impurities.*—Copper, iron, and carbonates.

ACTIONS AND USES.—*Externally*, lead oxide is desiccant and astringent; it is used in the preparation of lead plaster (diachylon plaster), which is occasionally employed as a surgical dressing for clean incised wounds of a minor nature.

Internally lead oxide is not prescribed.

Plumbi Carbonas.—Carbonate of Lead; White Lead (*not official*).

PREPARED by exposing lead to the vapour of acetic acid and simultaneously to air charged with carbonic acid.

ACTIONS AND USES.—*Externally* white lead is astringent and sedative, and applications containing white lead are still commonly employed for the horse. The following is a useful formula:

Pulv. plumbi carb., ʒi.; pulv. plumbi acet., ʒi.; pulv. camphoræ, ʒss.; ol. eucalypti, ʒss.; lanolin, ʒvi. Mix.

Internally it is not used.

Plumbi Acetas (Plumb. Acet.).—Lead Acetate; $\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$; 'Sugar of Lead.'

Source.—By dissolving lead oxide or carbonate in acetic acid. $\text{PbO} + 2\text{HC}_2\text{H}_3\text{O}_2 + 2\text{H}_2\text{O} = \text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$.

Characters.—Small white monoclinic prisms or crystalline masses, slightly efflorescent; odour acetous; taste sweet, astringent. *Solubility*.—1 in 2.5 of water, solution slightly acid; 1 in 30 of alcohol 90 per cent. *Incompatibles*.—Hard water, mineral acids, and salts, vegetable acids, alkalies, lime-water, potassium iodide, all vegetable astringents, preparations of opium, albuminous liquids. *Impurities*.—Other metals, chlorides and nitrates.

Doses.—Horses and cattle, ʒss. to ʒi.; dogs, gr. ss. to grs. ii.

ACTIONS.—*Externally* lead acetate is an astringent and local sedative.

Internally, it is an astringent and styptic.

MEDICINAL USES.—*Externally*, lotions containing acetate of lead are useful as cooling and sedative applications to strained tendons, bruises, and superficial inflammatory conditions. The familiar 'White Lotion' largely employed as an astringent in veterinary practice is composed of 1 part acetate of lead and $\frac{3}{4}$ part sulphate of zinc, dissolved in 20 to 30 parts of water. Although chemically incompatible, the combination proves a useful one.

Internally, as an astringent it is administered usually in combination with opium in obstinate cases of diarrhoea and dysentery. As a styptic or hæmostatic, it is sometimes prescribed in hæmorrhage from the stomach or intestines.

Liquor Plumbi Subacetatis Fortis (Liq. Plumb. Subacet. Fort.).—Strong Solution of Lead Subacetate; Goulard's Extract; $Pb_2O \cdot (CH_3 \cdot COO)_2$, dissolved in water.

Source.—Made by dissolving lead acetate 250 in water 750, adding lead oxide 175, filtering and washing the filter with water to 1,000. $PbO + Pb(C_2H_3O_2)_2 = Pb_2O \cdot (C_2H_3O_2)_2$.

Characters.—A clear, colourless liquid, with sweet, astringent taste and alkaline reaction. Sp. gr. 1.275. *Incompatibles*.—Those of lead acetate, also mucilage.

Liquor Plumbi Subacetatis Dilutus (Liq. Plumb. Subacet. Dil.).—Goulard's Lotion, Goulard Water; Strong Solution of Lead Subacetate, 12.5; Water, recently boiled and cooled, 1,000. Dilute solution of lead subacetate should be freshly prepared.

ACTIONS AND USES.—Both these preparations are astringents and local sedatives. Goulard's extract diluted with 6 parts of olive-oil or glycerin forms a useful liniment in seborrhœa in horses. It is also employed as a local application in irritable conditions of the skin.

In canine practice, liniments containing lead must be used with caution, as the animals may lick the parts, and toxic symptoms result.

Dilute solutions of Goulard's lotion are sometimes employed as collyria in catarrhal inflammations of the eye, but are contra-indicated if abrasion of the cornea be present, as an opacity due to the formation of albuminate of lead may result. Diluted

with an equal part of methylated spirit and with 8 to 10 parts of water, Goulard's extract forms a useful lotion in cases of strained tendons, etc.

Glycerinum Plumbi Subacetatis (*not official*).

Source.—By evaporating the strong solution, 5, to dryness on water-bath; adding glycerin 5; warming till dissolved, cooling, and adding water till sp. gr. is 1.48.

The glycerinum plumbi subacetatis, when diluted with water, forms a useful application for eczema in the horse.

Plumbi Iodidum.—Lead Iodide; PbI_2 (*not official*).

Source.—Made by mixing solutions of lead acetate or nitrate and potassium iodide, and drying the precipitate.

Characters.—A heavy bright-yellow powder; tasteless; odourless. *Solubility*.—1 in 200 of boiling water, falling out as brilliant golden-yellow crystalline scales as the solution cools.

Unguentum Plumbi Iodidi (*not official*).—Lead Iodide, 10; with 90 of Benzoated Lard (Benzoated Suet in India).

Lead iodide is occasionally employed in the form of the ointment as an absorbent application to enlarged joints, glandular swellings, etc., in the horse.

ZINCUM.

GENERAL ACTIONS OF ZINC SALTS.—The salts of zinc are antiseptic, astringent; the soluble salts are irritant.

Zinci Oxidum (Zinc. Oxid.).—Zinc Oxide; ZnO .

Source.—Made from metallic zinc by combustion in air.

Characters.—A soft, white or nearly white, tasteless and inodorous powder, becoming pale yellow when heated. Insoluble in water.

Impurities.—Carbonates, chlorides.

Unguentum Zinci Oxidi (Ung. Zinc. Oxid.).—Zinc Ointment; Zinc Oxide, 150; Simple Ointment, 850.

ACTIONS AND USES.—*Externally* zinc oxide is an astringent and desiccant, and is largely used as a dressing in eczema, either as a dusting powder or as an ointment. Combined with iodoform, it is commonly employed as an antiseptic astringent dressing. It also forms a useful application in otorrhoea in dogs.

Zinc ointment is mildly astringent and is largely employed in canine practice.

Internally the oxide of zinc is astringent, but is seldom employed for this purpose.

Zinci Carbonas (*not official*).—Zinc Carbonate; $ZnCO_3, 2Zn(OH)_2, H_2O$; Zinc Hydroxycarbonate; Calamine.

Source.—Produced by the interaction of zinc sulphate and sodium carbonate. $3ZnSO_4 + 3H_2O + 3Na_2CO_3 = ZnCO_3, 2Zn(OH)_2, H_2O + 2CO_2 + 3Na_2SO_4$.

Characters.—A white, tasteless, inodorous powder, insoluble in water. Entirely soluble in diluted nitric acid. *Impurities.*—Sulphates and chlorides; other metals.

The carbonate possesses actions and uses similar to those of the oxide of zinc.

Calamina Præparata.—Prepared Calamine (*not official*).

An insoluble pink powder, obtained by calcining native calamine (zinc carbonate) and reducing it to an impalpable powder.

Its actions and uses are similar to those of the oxide of zinc.

Zinci Sulphas (Zinc. Sulph.).—Zinc Sulphate; $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$.

Source.—Formed by the interaction of zinc and diluted sulphuric acid.

Characters.—Colourless, transparent prismatic crystals; taste metallic, styptic. *Solubility.*—10 in 7 of water; insoluble in alcohol. *Impurities.*—Acetates, chlorides; other metals.

Doses.—As an emetic for dogs, grs. iii. to grs. x., dissolved in about 2 ounces of warm water.

ACTIONS AND USES.—*Externally*, by precipitating albumin, zinc sulphate is astringent, and being also antiseptic, is employed to check discharges such as those of leucorrhœa from the genito-urinary passages.

In catarrhal conditions of the conjunctiva, after the acute stage has passed, a solution containing 2 grains of sulphate of zinc to the ounce of distilled water, applied with an eye-dropper twice daily, proves useful.

A combination of sulphate of zinc with acetate of lead and water forms the familiar 'White Lotion' (p. 133). A chemical interchange occurs, the acetate of zinc is formed in solution, and is the active constituent in this lotion; the sulphate of lead, being insoluble, is thrown down as a white precipitate.

Internally, sulphate of zinc is an intestinal astringent, but is now seldom employed for this purpose. As a local emetic, when given dissolved in warm water, zinc sulphate acts promptly in the dog, producing little prostration or nausea.

Zinci Chloridum (Zinc. Chlorid.).—Zinc Chloride; ZnCl_2 .

Source.—Produced by the interaction of hydrochloric acid and zinc.

Characters.—Colourless opaque rods or tablets, very deliquescent and caustic. *Solubility.*—3 in 1 of water; 1 in 1 of alcohol 90 per cent; and ether. *Impurities.*—Sulphates; other metals.

ACTIONS AND USES.—Zinc chloride is a powerful caustic, producing this effect by coagulating albumin and abstracting water from the tissues. Carefully applied in solution, it proves useful as a stimulant to unhealthy ulcers. It was a favourite application in the treatment of sinuses and fistulæ, but these are now treated more rationally by surgical methods.

A 10 per cent. solution of the drug is an efficient germicide for the disinfection of animal houses, but it is now seldom employed for this purpose.

Chloride of zinc is an irritant and corrosive poison, and is not used medicinally.

ARGENTUM.

Argenti Nitras (Argent. Nit.).—Silver Nitrate; AgNO_3 ; Lunar Caustic.

Source.—Prepared by the action of nitric acid on silver.

Characters.—Colourless tabular prisms; taste bitter, metallic. *Solubility.*—2 in 1 of water; slightly soluble in alcohol 90 per cent. (1 in 18); soluble in ether and glycerin. *Incompatibles.*—Alkalies and their carbonates, chlorides, acids (except nitric and acetic) potassium iodide, solutions of arsenic, and astringent infusions. *Impurities.*—Other metals; other nitrates, detected by evaporation of filtrate after precipitation with HCl.

Argenti Nitras Induratus (Argent. Nit. Indur.).—Toughened Caustic.

Source.—Prepared by fusing silver nitrate, 95, and potassium nitrate, 5; and pouring the mixed product into proper moulds.

Characters.—White or greyish-white cylindrical rods or cones; freely soluble in distilled water; only sparingly in alcohol 90 per cent.

ACTIONS AND USES.—*Externally*, nitrate of silver is caustic and astringent. Any excess being precipitated by the chlorides of the tissues the action is limited; silver nitrate therefore represents an example of what is known as a controllable caustic. It coagulates albumin and forms a protective eschar under which healing proceeds; the eschar tends to contract, and thus a slight pressure is exerted on the part. As its action is confined to the part to which it is applied, it is largely employed for the purpose of controlling exuberant granulations in wounds. It constricts dilated vessels and lessens secretion from mucous membranes. When applied to a raw surface a white film is produced, due to the formation of chloride of silver; this soon becomes dark in colour.

In ophthalmia, when the acute inflammation has subsided, a collyrium containing from $\frac{1}{2}$ grain to 2 grains to the ounce is useful.

In otorrhoea in dogs, when ulceration of the internal ear is present, a solution of nitrate of silver sometimes proves beneficial, but must be used with care.

If the solid nitrate of silver be employed in the treatment of ulcers of the buccal mucosa, care should be taken that the agent be not swallowed by the patient.

Internally, in medicinal doses silver nitrate is an intestinal astringent, but is seldom employed for this purpose in veterinary

practice. In toxic doses it is an irritant poison. The antidote is common salt, which converts it into the insoluble chloride. Demulcents should also be given freely.

Protargol.—Silver Protein (*not official*), an antiseptic possessing deep penetrating powers. It does not coagulate albumin, and in solutions of $\frac{1}{2}$ to 5 per cent. is practically non-irritant when instilled into the eye.

Argyrol (*not official*) contains 30 per cent. of silver combined with a protein, and is used as a collyrium in aqueous solutions of 5 to 50 per cent. It resembles protargol in its actions, and is non-irritant.

Protargol and argyrol have largely replaced silver nitrate in ophthalmic practice.

FERRUM.

GENERAL ACTIONS.—The ferric salts of iron, such as the perchloride, are strongly astringent, and in toxic doses are irritant and corrosive. The ferrous salts are mild astringents and are also prescribed as hæmatinics; these are represented by the phosphate and the carbonate.

In whatever form iron is administered *per os*, it is mainly converted into ferric chloride in the stomach, and on becoming mixed with the alkaline contents of the intestine, the chloride is converted into the carbonate and oxide of iron; these are later converted into the ferric sulphate and tannate on their meeting with sulphuretted hydrogen and tannic acid in the colon.

Only a very minute portion of the iron is absorbed, and such absorption occurs in the duodenum. The iron is taken up by the leucocytes, and ultimately reaches the portal vein. The excess is stored in the liver, and to some extent in the spleen and bone marrow.

Iron is an essential constituent of every living cell in the body. About 75 per cent. of absorbed iron is combined as hæmoglobin, but it is now recognized that iron cannot be combined in the absence of minute quantities of copper. Iron is commonly prescribed as a general hæmatinic in the treatment of conditions associated with anæmia and debility.

Certain forms of 'pine' in sheep and young cattle have been regarded as representing an iron deficiency, since the administration of iron preparations, particularly the crude iron oxide, proved of both curative and prophylactic value. Recent research has shown that the essential cause of such forms of pine is a deficiency of cobalt, which is required in only minute quantity and which occurs in crude preparations of iron as an impurity. In practice, however, it has been generally found preferable to

treat cobalt deficiency pine by allowing the animals free access to crude iron oxide; this obviates the labour and expense of uniformly incorporating minute quantities of cobalt in a mineral mixture; further, there is some evidence that iron oxide possesses vermifugal properties.

Iron therapy has proved of value in the prevention of nutritional anæmia in young pigs. Ferrous sulphate (3ii.) and copper sulphate (3ss.) are dissolved in a pint of water; this solution is sprinkled over 50 lbs. weight of moist soil, which is then thoroughly mixed. The treated soil is placed in a corner of the farrowing pen, and should be renewed once or twice weekly. Alternatively the young pigs may be given Syrupus Ferri Phosphatis Compositus in barley water; this they drink readily. One ounce of the syrup is added to each pint of freshly prepared barley water and sufficient given to allow 1 drachm of the syrup for each pig daily. The barley water must be freshly prepared each day.

INCOMPATIBLES OF PREPARATIONS OF IRON.—Alkalies and their carbonates, lime-water, and all preparations containing tannin.

FERROUS SALTS.

Ferri Sulphas (Ferr. Sulph.).—Ferrous Sulphate; $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

Source.—Prepared by the interaction of diluted sulphuric acid and iron.

Characters.—Pale bluish-green powder, or oblique rhombic green prisms; taste astringent. **Solubility.**—1 in $1\frac{1}{2}$ of water; insoluble in alcohol 90 per cent. **Impurities.**—Persalts; other metals.

Doses.—Horses, 3ss. to 3ii.; cattle, 3ii. to 3iv.; sheep, grs. x. to grs. xxx.; pigs, grs. x. to grs. xx.; dogs, gr. i. to grs. v. Given twice daily. Horses and cattle take it readily in the food in the form of powders.

Ferri Sulphas Exsiccatus (Ferr. Sulph. Exsic.).—Exsiccated Ferrous Sulphate; $\text{FeSO}_4 \cdot \text{H}_2\text{O}$.

Source.—Made by heating the sulphate to 100°C . to remove part of water of crystallization; contains 80 per cent. of anhydrous FeSO_4 .

Characters.—A nearly white powder, slowly but entirely soluble in water.

Doses.—Half those of the crystalline salt.

MEDICINAL USES.—*Externally*, sulphate of iron is an astringent and antiseptic, but is not employed for these purposes.

Internally, sulphate of iron is extensively prescribed in equine practice as a hæmatinic and general tonic. It is somewhat irritant and astringent, and is therefore contraindicated in cases in which an irritable condition of the stomach is present.

As a general tonic, it is usually prescribed with nux vomica, quinine, or a vegetable bitter, such as gentian (although chemi-

ally incompatible with all vegetable drugs which contain tannin). In solution with vegetable astringents, it forms a black-coloured mixture, due to the production of tannate of iron.

The less astringent preparations of iron are preferable in conditions of debility, such as occur after attacks of influenza and respiratory affections. In combination with other drugs, sulphate of iron is employed as a vermicide.

The less astringent preparations of iron should always be prescribed in canine practice in preference to the sulphate.

Ferri Carbonas Saccharatus (Ferr. Carb. Sacch.).—Saccharated Iron Carbonate; $x\text{FeCO}_3, y\text{Fe(OH)}_2$; Ferrous Carbonate, more or less oxidized, mixed with Glucose, and containing not less than 50 per cent. of ferrous salts calculated as Ferrous Carbonate, FeCO_3 .

Source.—Made by precipitating a hot solution of ferrous sulphate 97·5, containing glucose 15, with a hot solution of sodium carbonate 105, washing the precipitate, mixing it with glucose 15, and drying. $\text{FeSO}_4 + \text{Na}_2\text{CO}_3 = \text{FeCO}_3 + \text{Na}_2\text{SO}_4$.

Characters.—A greenish-brown powder, with a sweet, feebly chalybeate taste. *Impurities*.—Sulphate; excess of iron oxide.

Doses.—Horses, ʒii. to ʒiv.; sheep and pigs, gr. xx. to ʒi., given in the food twice daily; dogs, grs. v. to grs. xv. in the form of pills twice a day.

ACTIONS AND USES.—This preparation of iron does not tend to cause gastric irritation or to derange digestion, and is prescribed as a hæmatinic and general tonic in convalescence from debilitating affections.

Pilula Ferri Carbonatis (Pil. Ferr. Carb.).—Iron Pill, 'Blaud's Pill.' Exsiccated Ferrous Sulphate, 34; Exsiccated Sodium Carbonate, 21; Gum Acacia, 8; Tragacanth, 2; Glucose, 31; Water, 2. Contains 22·5 per cent. of Ferrous Carbonate.

Dose.—Dogs, grs. v. to grs. x.

MEDICINAL USES.—This is a useful tonic and hæmatinic pill for dogs. In combination with quinine, nux vomica, and aloin, it forms a tonic laxative, which is prescribed in constipation depending on intestinal atony. The following formula is useful: Blaud's pill, 3 grs.; quinine sulphate, $\frac{1}{2}$ gr.; extract of nux vomica, $\frac{1}{8}$ gr.; and aloin, $\frac{1}{4}$ gr.

Ferri Phosphas (*not official*)—Phosphate of Iron—is a combination of ferrous phosphate and ferric phosphate. It combines the actions of iron and phosphorus, and is prescribed chiefly in canine practice as a hæmatinic.

Syrupus Ferri Phosphatis Compositus (Syr. Ferr. Phosph. Co.).—Compound Syrup of Ferrous Phosphate. Parrish's Food. 1 fl. dr. contains ferrous phosphate, $\frac{1}{2}$ gr.; calcium phosphate, $\frac{1}{4}$ gr., and traces of sodium and potassium phosphate.

Dose.—Dogs, ʒss. to ʒi.; young pigs, ʒi. once daily.

Syrupus Ferri Phosphatis cum Quinina et Strychnina (Syr. Ferr. Phosph. c. Quinin. et Strych.).—Syrup of Phosphate of Iron with Quinine and Strychnine. Easton's Syrup. 1 fl. dr. contains 1 gr. anhydrous ferrous phosphate, about $\frac{2}{3}$ gr. quinine sulphate, and about $\frac{1}{60}$ gr. strychnine hydrochloride.

Dose.—Dogs, ℥v. to ℥xxx.

This preparation is prescribed as a tonic. Because of the high proportion of strychnine which it contains, it must be employed with great caution.

Syrupus Ferri Iodidi (Syr. Ferr. Iod.).—Syrup of Ferrous Iodide. 1 fl. dr. contains 3.75 gr. of ferrous iodide.

Dose.—Horses ʒi.; dogs, ʒss.

The Syrup of Ferrous Iodide is employed as a tonic and alterative.

PREPARATIONS OF THE FERRIC SALT.

Liquor Ferri Perchloridi Fortis (*not official*).—Strong Solution of Ferric Chloride.

Source.—Made by (1) dissolving iron (in wire) in hydrochloric acid and water; (2) adding hydrochloric acid, and pouring into nitric acid; evaporating; and adding HCl and water. (1) $\text{Fe} + 2\text{HCl} = \text{FeCl}_2 + \text{H}_2$. (2) $6\text{FeCl}_2 + 6\text{HCl} + 2\text{HNO}_3 = 3\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O} + 2\text{NO}$.

Characters.—An orange-brown liquid with a strong styptic taste; miscible with water and alcohol in all proportions. Sp. gr. 1.49. 20 g. iron in 100 ml., or 20 gr. in 110 min. *Impurities*.—Ferrous salts; other metals. The strong solution is not used internally.

Liquor Ferri Perchloridi (Liq. Ferr. Perchlor.).—Solution of Ferric Chloride. An aqueous solution containing 15 per cent. of Ferric Chloride.

Tinctura Ferri Perchloridi (*not official*).—Tincture of Ferric Chloride: 25 of Strong Solution; Alcohol 90 per cent., 25; Water to 100.

MEDICINAL USES.—*Externally* these preparations are powerful styptics, but exert very corrosive actions on the tissues.

Internally the medicinal solution and the tincture are hæmatinics and general tonics, but because of their nauseous taste and tendency to cause gastric irritation, less astringent preparations of iron are preferable.

In purpura hæmorrhagica, the tincture of iron is sometimes prescribed, but its value is doubtful.

In canine practice, the less astringent preparations of iron are much more suitable.

THE FERRIC OXIDE.

Ferri Peroxidum Humidum.—Ferri Peroxidum Hydratum; Sesquioxide of Iron; Moist Ferric Oxide, with about 86 per cent. of uncombined water (*not official*).

Prepared by mixing 3 parts of liquor ferri perchloridi and 1 part of sodium carbonate, diluted with water; the precipitated iron oxide is then obtained by filtration.

MEDICINAL USES.—This is the most effectual antidote for arsenical poisoning. It converts the arsenious acid into an insoluble arsenite, and should be given freshly prepared in warm water and in large amounts at frequent intervals.

In cases of emergency the solution of perchloride of iron may be mixed with a solution of carbonate of sodium or of ammonia and the oxide filtered off through a handkerchief (see p. 158).

Liquor Ferri Dialysatus—Solution of Dialyzed Iron (*not official*).

Contains about 5 per cent. ferric oxide.

DOSES.—Horses, $\frac{3}{4}$ ss. to $\frac{3}{4}$ i.; dogs, ℥x. to ℥xx.

MEDICINAL USES.—This preparation is useful as a tonic and hæmatinic in conditions in which the more astringent preparations of iron would be inadmissible. Its usefulness is limited by reason of its being compatible with few drugs, while dilution with water throws down a deposit of the oxide; when dispensed, it should, therefore, be mixed with two parts of glycerin. It is stated to be superior to the moist oxide of iron as an antidote to arsenic.

THE SCALE PREPARATIONS OF IRON.

Ferri et Ammonii Citras (Ferr. et Ammon. Cit.).—Iron and Ammonium Citrate.

Source.—Made by precipitating diluted solution of ammonia with diluted solution of ferric sulphate; dissolving the resulting ferric hydroxide in a hot solution of citric acid; neutralizing with ammonia; evaporating, and drying in thin layers on porcelain or glass plates.

Characters.—Deep-red, transparent scales; taste slightly sweet and astringent. *Solubility.*—2 in 1 of water, solution feebly acid; almost insoluble in alcohol 90 per cent. *Impurities.*—Tartrates; alkaline salts.

DOSE.—Dogs, grs. v. to grs. x., given in solution with syrup.

Ferri et Quininæ Citras (Ferr. et Quinin. Cit.).—Iron and Quinine Citrate.

Source.—Made like ferri et ammonii citras, freshly precipitated quinine being also dissolved in the citric acid solution.

Characters.—Greenish-golden-yellow scales; somewhat deliquescent; taste bitter and chalybeate; contains 15 per cent. of quinine. *Solubility.*—2 in 1 of water, solution slightly acid. *Impurities.*—Alkaline salts; other alkaloids.

DOSE.—Dogs, grs. v. to grs. x., in solution with syrup.

These preparations are useful hæmatinics in canine practice, being almost devoid of astringency, and possessing little tendency to cause constipation or gastric irritation. They can be prescribed in cases in which other preparations of iron would not be tolerated.

CUPRUM.

The general actions of the soluble salts of copper resemble those of zinc and silver.

Toxic doses are irritants, producing colicky pains and diarrhoea. In cases of chronic poisoning nervous symptoms with muscular weakness are manifested.

TOXIC ACTIONS.—Copper-poisoning may result from contaminated pastures in the neighbourhood of copper-smelting works, and may also result from the use of copper vessels in cooking food for animals.

ANTIDOTES.—Demulcents; white of egg, barley-water, gruel. If pain be a prominent symptom, the hypodermic injection of morphine is indicated.

Cupri Sulphas (Cupr. Sulph.).—Copper Sulphate; $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$; Cupric Sulphate; 'Blue Vitriol'; 'Bluestone.'

Source.—Obtained by the interaction of water, sulphuric acid and copper or cupric oxide, evaporating and crystallizing. $4\text{H}_2\text{SO}_4 + \text{Cu}_2 = 2\text{CuSO}_4 + 2\text{SO}_2 + 4\text{H}_2\text{O}$.

Characters.—Blue triclinic prisms. **Solubility.**—1 in 3.5 of cold water, yielding a strongly acid solution; very soluble in glycerin; almost insoluble in alcohol 90 per cent. **Incompatibles.**—Alkalies and their carbonates, lime-water, mineral salts (except sulphates), iodides and most vegetable astringents. **Impurities.**—Other metals.

ACTIONS AND USES.—*Externally*, copper sulphate is antiseptic, astringent, and caustic, these actions being due to its precipitating albumin.

Sulphate of copper is extensively employed as an astringent and caustic in suppressing exuberant granulations and in the treatment of ulcers. It may be applied in the form of a solution or as a powder. Combined with the sulphates of iron and zinc, it forms a useful dressing in canker of the horse's foot.

In foot-rot in sheep, sulphate of copper, in combination with lard and tar, is a serviceable application.

As an astringent collyrium for granular conjunctivitis in the dog, 1 or 2 grains to the ounce of distilled water is employed.

Combined with acetate of lead, sulphate of zinc, and water, it forms a useful astringent lotion in foetid seborrhoea and fissured heels in horses.

Internally it is astringent and irritant, and a prompt emetic in those animals capable of vomiting.

As an intestinal astringent, it is occasionally prescribed for the horse in doses of 1 drachm, administered in bolus; but other agents are preferable.

As a local emetic, it is sometimes employed in canine practice in narcotic poisoning, from 6 to 10 grains being dissolved in water and given as a draught.

Sulphate of copper is an antidote to phosphorus-poisoning, and for this purpose is administered in small doses frequently repeated. The copper, by becoming deposited on the phosphorus, is believed to render it inert.

Copper sulphate has become recognized as a valuable vermicide in the case of the small nematode worms infesting the stomach and bowels of cattle and sheep, and is especially advised in the treatment of hæmonchosis. Of a 1 per cent. solution of the salt, cattle are given 3x., sheep 3iii.ss., lambs 3i. to 3i.ss., repeated monthly (see also Tobacco, p. 254). Solutions of copper sulphate have been shown to cause closure of the oesophageal groove and therefore pass directly to the abomasum. It has been found that sheep do not require to be fasted for a period longer than sixteen to twenty-four hours before administering copper sulphate. Longer periods of fasting do not increase the anthelmintic efficacy of the drug.

Copper is a specific in the prevention of swayback in lambs. Ewes in the affected districts, throughout the whole period of their pregnancy, are allowed free access to salt licks containing 0.3 per cent. copper sulphate; alternatively, licks containing a higher concentration of copper sulphate (1 per cent.) may be employed during the last few weeks of pregnancy.

Minute quantities of copper in the presence of iron appear to be necessary for the proper synthesis of hæmoglobin. Copper is therefore prescribed with iron in the treatment of secondary anæmias.

COBALTUM.

Recent research has shown that an absence of cobalt in pasture may be an important factor in the production of nutritional anæmia, especially in sheep. This condition, known as cobalt deficiency pine, may be prevented and in many cases cured by the administration of cobalt chloride in extremely small doses: 5 m.g. daily for about 14 consecutive days.

Cobalt deficiency in sheep can be prevented by dressing grassland with phosphatic manures with which a small quantity of cobalt chloride (2 lbs. to the acre) has been incorporated. Salt licks containing cobalt chloride are prepared commercially (see also p. 137).

HYDRARGYRUM.

All salts and preparations of mercury are derived either directly or indirectly from the metal itself.

GENERAL ACTIONS.—In virtue of their power to precipitate proteins, and because of their toxic action on living tissue, salts of mercury are corrosive, irritant, astringent, and antiseptic.

Mercuric salts, being soluble, come into more intimate contact with the tissues, possess a more powerful local action, and are absorbed more readily than are mercurous salts, such as calomel, which are almost insoluble and therefore possess only slight local action.

Mercury, when given in continued doses, acts as a sialagogue; this is due to its irritant action on the salivary glands, by which it is partly excreted from the body. This effect is produced by all preparations of the drug and by all methods of administration. Calomel and blue pill, because of their insolubility, are only absorbed in very small amounts when given in medicinal doses. They exert a purgative effect by causing slight irritation of the intestines. Formerly mercury was regarded as a direct cholagogue, but it does not increase the secretion of bile (see p. 66). The drug is slowly eliminated from the body, and when administered in continued doses it quickly enters the tissues from the blood, being found in largest amount in the liver and kidneys. It is excreted chiefly by the large intestine as the sulphide, also in the urine and saliva. During its excretion in the urine it exerts an irritant action on the kidneys and produces a moderate diuretic effect. Large doses may induce acute nephritis.

TOXIC EFFECTS.—Mercury is a cumulative poison, and its continued administration leads to the production of mercurialism or hydrargyrim. This condition is characterized by salivation, tenderness of the mouth and gums, impaired appetite, nephritis, dyspepsia, diarrhoea, muscular tremors, emaciation, osseous affections, and in some cases the appearance of eczematous eruptions on the skin.

ANTIDOTES.—As the albuminate of mercury is soluble in solutions of potassium iodide, this agent is commonly prescribed as an antidote in mercurialism, in conjunction with saline aperients. Mouth-washes containing chlorate of potash are also indicated.

Dogs are more susceptible to the action of mercurials than are horses or cattle, and great care is essential in prescribing these agents internally, or in applying dressings containing them.

PREPARATIONS CONTAINING FREE MERCURY.

Pilula Hydrargyri (Pil. Hydrarg.).—Mercury Pill; 'Blue Pill'; 1 in 3, with Syrup Glucose and Liquorice Root.

Dose.—Dogs, grs. ii. to grs. iv.

This is prescribed in canine practice as a cathartic, in combination with the compound pill of colocynth and hyoscyamus.

Hydrargyrum cum Creta (Hydrarg. c. Creta).—Mercury with Chalk; 'Grey Powder'; 1 in 3, with Prepared Chalk.

DOSE.—Dogs, gr. ss. to grs. iv., according to the age and size of the patient. It is best administered in pills or tablets.

DOSE.—Foals and calves, grs. v. to grs. xv.

MEDICINAL USES.—As a laxative, antacid, and alterative, grey powder is prescribed in cases of bilious indigestion and diarrhoea occurring in young foals and calves.

It is useful in canine practice, being mild and non-irritating in its action.

It is specially indicated in dyspepsia depending on hepatic irregularities, which occurs in young dogs, and in small doses frequently repeated it sometimes is of benefit in jaundice.

Unguentum Hydrargyri (Ung. Hydrarg.).—Mercury Ointment; Blue Ointment; Mercury, 30; Prepared Suet, 5; Benzoated Lard (in India, Benzoated Suet), 65; 1 in 3 with ointment base.

USES.—Mercury ointment forms an efficient parasiticide dressing for ringworm. For this purpose it should be used sparingly and applied with only slight friction, as it is undesirable that it be absorbed through the skin.

Linimentum Hydrargyri (*not official*).—Mercury Ointment, 5; Solution of Ammonia, 4; and Camphor Liniment, 8. Contains 8.8 per cent. of Mercury.

THE OXIDES OF MERCURY AND THEIR PREPARATIONS.

Hydrargyri Suboxidum (*not official*).—Black Oxide of Mercury (Hg_2O).

This is the active constituent in the following lotion:

Lotio Hydrargyri Nigra (Lot. Hydrarg. Nigr.).—Black Mercurial Lotion; 'Black Wash'; Calomel, 0.7; Glycerin, 5; Solution of Lime to make 100; $2\text{HgCl} + \text{Ca}(\text{OH})_2 = \text{Hg}_2\text{O} + \text{CaCl}_2 + \text{H}_2\text{O}$; the Black Oxide being formed.

Black wash is occasionally prescribed as a stimulant and astringent to ulcers and unhealthy surfaces.

Hydrargyri Oxidum Rubrum (*not official*).—Red Mercuric Oxide; HgO ; 'Red Precipitate.'

Source.—Made by heating mercurous nitrate (made from mercury and diluted nitric acid) until acid vapours cease.

Characters.—Orange-red, crystalline scales or powder, insoluble in water. Evolves O gas when heated, Hg remaining behind. **Impurities.**—Red lead and brick-dust (non-volatile): nitrates (yielding nitrous vapours by heat).

Unguentum Hydrargyri Oxidi Rubri (*not official*).—Red Mercuric Oxide Ointment; Red Precipitate Ointment; 10 per cent. with Paraffin Ointment.

Red precipitate ointment is sometimes used as a stimulant and astringent application in chronic seborrhœa and fissured heels.

Hydrargyri Oxidum Flavum (Hydrarg. Oxid. Flav.).—Yellow Mercuric Oxide; HgO .

Source.—Made by precipitating a solution of mercuric chloride with sodium hydroxide. $\text{HgCl}_2 + 2\text{NaOH} = \text{HgO} + 2\text{NaCl} + \text{H}_2\text{O}$.

Characters.—A yellow amorphous powder, insoluble in water; entirely volatilized by heat. Has the same composition as the red oxide, but is non-crystalline.

This is the active constituent in the following lotion:

Lotio Hydrargyri Flava (*not official*).—Yellow Mercurial Lotion; 'Yellow Wash'; Mercuric Chloride, 0.46; Solution of Lime, 100; $\text{HgCl}_2 + \text{Ca}(\text{OH})_2 = \text{HgO} + \text{CaCl}_2 + \text{H}_2\text{O}$; the Yellow Oxide being formed.

Unguentum Hydrargyri Oxidi Flavi (*not official*).—Yellow Mercuric Oxide Ointment; 2 per cent. in Soft Paraffin.

The uses of the preparations of the yellow oxide are similar to those of the black oxide and red oxide.

Oculentum Hydrargyri Oxidi (Oculent. Hydrarg. Oxid.) contains 1 per cent. of Yellow Mercuric Oxide.

The oculentum is applied in eczematous affections of the eyelids, corneal ulcerations, and chronic conjunctivitis. A small quantity placed between the eyelids is useful in ophthalmia, as it prevents the tendency of the eyelids to become adherent to each other by the drying of the discharge.

Hydrargyrum Oleatum (Hydrarg. Oleat.).—Oleated Mercury.

Source.—By triturating yellow mercuric oxide 20 with liquid paraffin 5, stirring in oleic acid 75, and heating.

Characters.—A yellow unctuous substance.

This is a diffusible, penetrating, absorbent preparation, occasionally employed in the treatment of ringworm, and enlarged or indurated glands.

THE CHLORIDES OF MERCURY AND THEIR PREPARATIONS.

Hydrargyri Subchloridum (Hydrarg. Subchlor.).—Mercurous Chloride; Calomel; HgCl .

Source.—Obtained as a sublimate when a mixture of mercurous sulphate and sodium chloride is heated.

Characters.—A dull-white, heavy, nearly tasteless powder. *Solubility*.—Insoluble in water, alcohol 90 per cent., and ether; entirely volatilized by heat. *Incompatibles*.—Bromides and iodides, nitro-hydrochloric acid, hydrocyanic acid, chlorides of the alkalies, solution of lime, iodoform. *Impurities*.—Mercuric chloride, soluble in water; other chlorides, non-volatile.

Doses.—As a cathartic: Horses, ʒi. to ʒii. ; cattle, ʒi. to ʒii. ; sheep and pigs, grs. xv. to grs. xxx.; dogs, gr. $\frac{1}{4}$ to gr. i.—usually combined with other purgatives.

ACTIONS.—*Externally*, calomel, in consequence of its insoluble character, is mild in its action as compared with the mercuric chloride. It is desiccant, stimulant, astringent, and antiseptic.

Internally it is purgative to all animals, acting chiefly on the small bowel, and produces this effect reflexly by irritation of the intestinal mucous membrane. Calomel is not a direct cholagogue, but by stimulating duodenal peristalsis it excites contraction of the gall-bladder and bile-ducts. When given as a purgative, its administration should be followed by a saline aperient, which, while assisting its action, prevents the absorption of the mercury.

Calomel possesses a diuretic action, which is believed to be more marked when it is combined with salines or resinous agents. If administered in repeated doses it produces the cumulative effects of mercury which have already been described.

In the horse an excessive dose may produce colicky pains and superpurgation. It is believed that this animal is not so susceptible to the toxic effects of the drug as are cattle.

Dogs are very susceptible to the action of calomel, and great care is necessary in computing suitable doses, especially for the smaller breeds.

Calomel exerts an antiseptic action on the intestinal canal.

MEDICINAL USES.—*Externally*, calomel in the form of ointment (1 to 8) is sometimes employed to allay the severe itching of certain skin affections in the horse, such as eczema. Combined with iodoform, oxide of zinc, and boric acid it forms an excellent application for the treatment of that affection known as 'thrush' in the horse's foot. The incompatibility of calomel and iodoform does not affect the value of the combination.

Internally, as a cathartic calomel is prescribed for the horse when full purgative effects are desired. For this purpose it is usually combined with aloes, and administered in bolus. A combination of calomel and aloin (2 drachms of each) forms a very efficient purgative, and is readily taken by some horses when mixed in a bran mash.

In the treatment of simple obstructive jaundice in the dog, small repeated doses of calomel are often beneficial. It should be administered in doses of $\frac{1}{10}$ grain every four hours until the bowels have acted and some improvement in the symptoms is observed. In young dogs and in the small breeds grey powder is preferred for this purpose.

Hydrargyri Perchloridum (Hydrarg. Perchlor.).—Mercuric Chloride; HgCl_2 ; Corrosive Sublimate.

Source.—Obtained as a sublimate by heating a mixture of mercuric sulphate, sodium chloride, and a little black oxide of manga-

nese. $\text{HgSO}_4 + 2\text{NaCl} + \text{MnO}_2 = \text{HgCl}_2 + \text{Na}_2\text{SO}_4 + \text{MnO}_3$. The manganese prevents the formation of calomel by setting free Cl, which converts the subchloride into the perchloride.

Characters.—Heavy, colourless crystalline masses; taste acrid, metallic. *Solubility*.—1 in 18 of water; 1 in 4 of alcohol 90 per cent.; 1 in 4 of ether; 1 in 2 of cold glycerin on trituration. *Incompatible* with alkalis and their carbonates, potassium iodide, lime-water, tartar emetic, silver nitrate, lead acetate, albumin, soaps and tannic acid preparations. *Impurities*.—Fixed salts (non-volatile).

ACTIONS.—*Externally* corrosive sublimate precipitates albumin, and is an active and penetrating caustic and escharotic. In the proportion of 1 part to 1,000 parts of water it forms a powerful germicide capable of destroying bacilli and their spores.

Internally, perchloride of mercury, being very soluble, possesses marked toxic properties. It is an irritant corrosive poison, causing gastro-enteritis and general collapse. Administered in small repeated doses, it produces mercurialism.

ANTIDOTES.—Egg albumin, which forms an insoluble albuminate; milk and flour may also be administered for a similar purpose.

MEDICINAL USES.—*Externally*, corrosive sublimate is chiefly employed as an antiseptic in the treatment of wounds and for general surgical work; as a disinfectant wash for the hands, solutions of 1 part in 1,000 parts of water are used.

For the irrigation of wounds aqueous solutions, varying in strength from 1 in 10,000 to 1 in 2,000, may be employed.

Perchloride of mercury possesses certain disadvantages as an antiseptic agent. In the case of extensive wounds, it may be absorbed and induce toxic effects. It has a corrosive action on steel and plated instruments. In combination with albumin it forms an inert and insoluble compound, but this can be obviated by adding 5 parts of tartaric acid to each part of the perchloride, and so preventing the formation of an albuminate. For general surgical purposes other antiseptics are preferable to this agent.

Formerly corrosive sublimate, in the form of powder and strong solutions, was extensively employed in the treatment of quittor and allied affections, but modern surgical methods have largely superseded its employment in these conditions.

In the treatment of traumatic arthritis with perforation, the following lotion is recommended: Perchloride of mercury, $\frac{1}{2}$ drachm; tincture of myrrh, 4 ounces; water, $\frac{1}{2}$ ounce.

Various forms of surgical dressings contain corrosive sublimate as an antiseptic agent, such as sublimate gauze (1 to 1,000) and sublimate wool (1 to 400).

Internally it is seldom prescribed.

Sal Alembroth.—Mercuric Ammonium Chloride (*not official*).

A solution—0.5 g. (8 gr.) of mercuric chloride to 30 ml. (1 fl. oz.) of distilled water, with 0.5 g. (8 gr.) of ammonium chloride.

Sal alembroth is a powerful antiseptic. It does not combine with albumin so readily as does corrosive sublimate, and so is less irritating. It is chiefly used in the preparation of surgical dressings (alembroth gauze 1 per cent.; alembroth wool 2 per cent.). Because of the fact that sal alembroth is very soluble, it is quickly washed out of dressings by wound discharge, and acts as an irritant; this disadvantage has limited its use.

Mercurio - Zinc Cyanide. $\text{Zn}_2\text{Hg}(\text{CN})_8$ (*not official*).—A white powder, tinted with aniline violet.

It is a reliable, non-irritating antiseptic, and is employed in the preparation of a gauze (3 per cent.), which is employed as a surgical dressing. It should be damped before use.

Hydrargyrum Ammoniatum (Hydrarg. Ammon.).—Ammoniated Mercury; NH_2HgCl ; 'White Precipitate.'

Source.—Made by precipitating a solution of mercuric chloride with dilute solution of ammonia; washing and drying. $\text{HgCl}_2 + 2\text{NH}_4\text{OH} = \text{NH}_2\text{HgCl} + \text{NH}_4\text{Cl} + 2\text{H}_2\text{O}$.

Characters.—A white, heavy, tasteless powder; insoluble in water, alcohol 90 per cent. and ether. Decomposed by water. *Impurities*.—As of the perchloride.

Unguentum Hydrargyri Ammoniatum (Ung. Hydrarg. Ammon.).—Ammoniated Mercury Ointment; 'White Precipitate Ointment'; 5 to 95 parts of Unguentum Simplex.

USES.—In the horse white precipitate ointment is useful in the treatment of seborrhoea, fissured heels, and in those affections of the skin known as mallenders and sallenders. The ointment is employed as a parasiticide dressing in ringworm. Because of the danger of absorption, and of the animal's licking the part to which the dressing is applied, this agent is not safe in canine practice.

THE IODIDE OF MERCURY AND ITS PREPARATION.

Hydrargyri Iodidum Rubrum (Hydrarg. Iod. Rubr.).—Mercuric Iodide; HgI_2 ; Biniiodide of Mercury; Red Iodide of Mercury.

Source.—Precipitated by the interaction of solutions of mercuric chloride and potassium iodide.

Characters.—A vermillion, crystalline powder; turns yellow by heat and then volatilizes. *Solubility*.—Almost insoluble in water; sparingly in alcohol 90 per cent.; freely and entirely in ether or in solution of potassium iodide. *Impurities*.—As of the perchloride.

DOSES.—Horses, grs. v.; cattle, grs. x.

ACTIONS AND USES.—*Externally*, the red iodide of mercury is an active counter-irritant and absorbent, which is extensively employed as an ointment in the treatment of diseased joints and the various forms of exostoses. If applied in sufficient strength, it penetrates deeply and acts as a suppurant. A safe

blistering ointment is prepared with 1 part of red iodide of mercury and 4 parts each of lanolin and soft paraffin. When severe counter-irritation is indicated, it is usual to combine equal parts of the red iodide of mercury and cantharides ointments.

In the treatment of bursal enlargements, a useful absorbent lotion is prepared by dissolving 1 drachm of the red iodide with a sufficiency of the iodide of potassium to render the former soluble in 12 ounces of water. This is applied daily until the part becomes tender and scaly, then discontinued for a time and reapplied.

The red iodide is also an efficient antiseptic, and for this purpose it enters into the composition of antiseptic soaps.

As an ointment (1 in 20 soft paraffin) it is occasionally used as a parasiticide in ringworm in cattle. The dressing must be used with caution, and should not be applied to lesions in the vicinity of the eye.

Internally, red iodide of mercury in medicinal doses is an alterative; in toxic doses it is an irritant poison. As a cheap substitute for iodide of potassium it is prescribed in lymphangitis in the horse, after the acute stage has passed, in doses of 5 grains three times daily. It is also used in scirrhus cord, and in tumours of the shoulder due to botriomycosis. A convenient solution is prepared by dissolving 1 drachm of the biniodide in 12 ounces of water by means of the addition of an equal amount of potassium iodide. Of this mixture 1 ounce may be given three times daily in the food.

A mixture of 5 grains of the biniodide with an equal amount of potassium iodide, given three times daily in solution, is prescribed in actinobacillosis in cattle, but the administration of larger doses of the iodide of potassium alone constitutes a more effective treatment.

Liquor Arseni et Hydrargyri Iodidi (Liq. Arsen. et Hydrarg. Iod.).—Solution of Arsenious and Mercuric Iodides; 'Donovan's Solution.'

Source.—Made by trituration and solution of 1 each of arsenious iodide and mercuric iodide in 100 of water. 1 gr. each of AsI_3 and HgI_2 in 110 min.

Characters.—A clear, pale-yellow liquid; taste metallic.

Doses.—Horses, ʒi. to ʒi. ; dogs, ʒi. to ʒi. .

This combines the alterative actions of arsenic and mercury, and is employed in the treatment of chronic scaly affections of the skin, and as a general tonic and alterative.

THE PREPARATIONS OF THE NITRATE OF MERCURY.

Unguentum Hydrargyri Nitratis Forte (Ung. Hydrarg. Nit. Fort.).—Mercuric Nitrate Ointment; 'Citrine Ointment.' Made by adding a cold solution of Mercury 10 in Nitric Acid 30 to Prepared Lard

(in India, Prepared Suet) 40, melted in Olive Oil 70; heating until the mixture froths up, and stirring till cold.

Unguentum Hydrargyri Nitratis Dilutum (Ung. Hydrarg. Nit. Dil.).—Diluted Mercuric Nitrate Ointment; 20 of Mercuric Nitrate Ointment in 80 of Soft Paraffin, yellow.

USES.—Dilute citrine ointment is occasionally used as a parasiticide, but is not a safe agent in canine practice, because of the danger of absorption, and of the dog licking the parts to which it is applied. In irritable discharging conditions of the eyelids, with chronic inflammation and ulceration of the hair follicles, a very dilute citrine ointment (1 to 7 of the dilute ointment), carefully applied, is a useful dressing.

Liquor Hydrargyri Nitratis Acidus (*not official*).—Acid Solution of Mercuric Nitrate; Mercuric Nitrate, $\text{Hg}(\text{NO}_3)_2$, in solution in Nitric Acid.

Source.—Made by dissolving 24 of mercury in 30 of nitric acid and 9 of water, and boiling.

Characters.—A colourless, strongly acid liquid; sp. gr. about 2.0. **Impurity.**—Mercurous nitrate, giving precipitate when dropped into diluted hydrochloric acid.

This is a strong caustic preparation seldom now employed in veterinary practice.

BISMUTHUM.

The salts of bismuth chiefly employed in veterinary practice are the subnitrate and the carbonate.

Bismuthi Carbonas (Bism. Carb.).—Bismuth Oxycarbonate; $(\text{Bi}_2\text{O}_2\text{CO}_3)_2, \text{H}_2\text{O}$.

Source.—Made by the interaction of bismuth nitrate and ammonium carbonate. $4\text{Bi}(\text{NO}_3)_3 + 4\text{N}_3\text{H}_{11}\text{C}_2\text{O}_5 + 3\text{H}_2\text{O} = (\text{Bi}_2\text{O}_2\text{CO}_3)_2, \text{H}_2\text{O} + 12\text{NH}_4\text{NO}_3 + 6\text{CO}_2$.

Characters.—A heavy whitish powder; insoluble in water; soluble with effervescence in nitric acid. *Incompatible* with acids, acid salts, tannin, and sulphur. **Impurities.**—Nitrates, chlorides, sulphates; other metals, selenium, and tellurium.

Doses.—Horses, ʒss. to ʒi.; dogs, grs. x. to grs. xxx.

Bismuthi Salicylas (Bism. Salicyl.).—Bismuth Salicylate.

Source.—A basic salt of varying composition, obtained by the interaction of solutions of bismuth nitrate and sodium salicylate.

Characters.—A white amorphous powder, odourless, tasteless. Insoluble in water.

Dose.—Foals and calves, grs. xv. to ʒi.; dogs, grs. v. to grs. xv.

Bismuthi Subnitrates (*not official*).—Bismuth Oxynitrate $\text{BiONO}_3, \text{H}_2\text{O}$.

Source.—Prepared by the interaction of bismuth nitrate and water. $\text{Bi}(\text{NO}_3)_3 + 2\text{H}_2\text{O} = \text{BiONO}_3, \text{H}_2\text{O} + 2\text{HNO}_3$.

Characters.—A heavy white powder, inodorous, in minute crystalline scales; insoluble in water; very faintly acid. *Incompatible*

with carbonates, bicarbonates, iodides, tannin, sulphur. *Impurities.*—As of the oxycarbonate.

Doses.—Horses, ʒss. to ʒi.; dogs, grs. x. to grs. xxx.

Liquor Bismuthi et Ammonii Citratis (*not official*).—‘*Liquor Bismuthi.*’

Source.—By mixing bismuth subnitrate 70 g. with citric acid 52 g. and water; allowing precipitate to settle; decanting liquid; washing precipitate, adding sufficient of solution of ammonia to dissolve it, and water to 1,000 ml.

Characters.—Colourless liquid; taste metallic, slightly alkaline; 10 ml. contain 0.5 g. bismuth oxide.

Dose for the dog, ℥xv. to ʒss.

ACTIONS AND USES.—*Externally*, bismuth exerts sedative, desiccant, and astringent actions.

Bismuth subnitrate, in the form of a paste prepared with white wax and hard paraffin, is sometimes employed in the treatment of sinuses and fistulæ. The preparation is first melted and sterilized. It is then drawn up into a glass syringe and injected into the sinus or fistula in a semi-fluid state, with light pressure. The subnitrate is contained in B.I.P.P. (see p. 218).

Internally, bismuth is a gastric and intestinal sedative and astringent, by lessening the irritability of the gastric nerves, and by forming an adhesive coating on the gastric and intestinal mucosa, and thus protecting it from irritation. Large doses, if given in a soluble form, are said to produce gastric irritation. Repeated doses cause the fæces to assume a leaden-gray colour, due to the formation of the sulphide.

It is seldom prescribed internally for horses, but is a valuable gastric sedative in canine practice. It is indicated in gastric catarrh and in dyspepsia accompanied by troublesome vomiting and gastric irritation. Bismuth salicylate is also employed as an intestinal sedative and antiseptic in cases of diarrhœa and intestinal irritation in calves, foals and dogs.

The *Liquor Bismuthi*, given either alone or combined with dilute hydrocyanic acid and spirit of chloroform, is a useful preparation for the dog.

In consequence of its acid reaction bismuth subnitrate is incompatible with sodium bicarbonate. The carbonate should therefore be employed when it is desired to prescribe bismuth with an alkali. As bismuth preparations are insoluble, it is desirable to suspend them in mixture by the addition of compound tragacanth powder or mucilage of tragacanth.

A combination of bismuth carbonate, magnesium carbonate, and sodium bicarbonate is found useful in gastric catarrh. Bismuth carbonate is opaque to the X rays, and if food with which this substance has been mixed be fed to small animals

before submitting them to X-ray examination, the alimentary tract can be examined radiographically (see p. 402).

Thioform (*not official*) is a basic dithio-salicylate of bismuth, which is used as a desiccant antiseptic for the dry dressing of wounds. It is non-irritant, non-toxic, and inodorous.

Bismuthi Subgallas—**Dermatol** (*not official*)—is employed as a substitute for iodoform. It promotes cicatrization in wounds, and, lessening the secretion from weeping surfaces, it is used as a dusting-powder in moist eczema. It is sometimes prescribed internally as an astringent in diarrhoea.

DOSE.—Dogs, grs. v. to grs. x.

Bismuthi Oxy-Iodogallas—**Airol**, **Airoform** (*not official*)—has properties similar to those of dermatol.

GROUP III—THE METALLOIDS.

ANTIMONIUM.

The only preparation of antimony of interest in veterinary practice is the antimonium tartaratum, or tartar emetic. The **LIQUOR ANTIMONII CHLORIDI**, or Butter of Antimony (*not official*), is a powerful escharotic which is now seldom employed, but was formerly used as a caustic application in 'canker' of the foot in the horse and 'foot-rot' in sheep.

Antimonii et Potassii Tartras (**Antimon. et Pot. Tart.**).—Tartarated Antimony; Potassio-tartrate of Antimony; Tartar Emetic; $[K(SbO)C_4H_4O_6]_2H_2O$.

Source.—Made by preparing a paste of antimonious oxide and acid potassium tartrate with water; setting aside until combination takes place; and purifying by crystallization from water. $(CHOH)_2COOH \cdot COOK + Sb_2O_3 = [K(SbO)C_4H_4O_6]_2H_2O$.

Characters.—Colourless transparent crystals, exhibiting triangular facets. Taste sweet and metallic. **Solubility.**—1 in 17 of water; slightly soluble in weak alcoholic liquids; almost insoluble in alcohol 90 per cent. Solutions faintly acid. **Incompatibles.**—Tannic acid and most astringent infusions, alkalies, lead salts. **Impurities.**—Cream of tartar, detected volumetrically and by solubility; other metals.

DOSE.—Horse, ʒi. to ʒii.

ACTIONS.—Tartar emetic, administered as a powder to horses and cattle, even in large amounts, produces no appreciable effects, other than a slight degree of nausea. If administered in solution, however, doses of from $\frac{1}{2}$ ounce to 2 ounces produce enteritis which may terminate in death. One drachm given by intravenous injection produces sweating, purging, salivation, and

attempts at vomiting; while 2 drachms cause death in from one and a half to three hours, preceded by vertigo and paralysis.

In the dog it causes local irritation of the stomach and is a powerful emetic; 1 to 3 grains produce vomiting in from ten to fifteen minutes; this action is prolonged, much nausea and depression resulting. It is also emetic when injected intravenously; this action is due to its being excreted into the stomach. It is an expectorant. The expectorant action results from the gastric irritation which reflexly increases the secretion of bronchial mucus.

TOXIC ACTIONS.—*Externally*, tartar emetic is a powerful irritant when applied to the skin; it irritates the orifices of the sweat glands and sebaceous follicles, and causes the formation of pustules with deep-seated painful inflammation of the part.

It is an irritant poison, causing gastro-enteritis, purging, cardiac depression, and collapse.

ANTIDOTES.—Tannic acid and substances containing tannin; these form an insoluble compound. Demulcents are also indicated, and stimulants if there are symptoms of collapse.

MEDICINAL USES.—*Externally*, the violence of its action precludes the use of tartar emetic as a counter-irritant.

Internally, tartar emetic is believed to exert an alterative action, and for this purpose is sometimes prescribed for horses in combination with other agents. It is also employed as a vermicide for the horse (dose, \mathfrak{z} i. to \mathfrak{z} ii.), in combination with sulphate of iron and gentian, and proves useful for the eradication of ascarides.

Antimony salts have proved of very real value in the treatment of leishmaniasis and bilharziasis; they are now, however, largely discontinued in trypanosomiasis and have been found ineffective in spirochætal infections.

Tartar emetic has been found of value in the treatment of 'red-water' in cattle (see p. 462).

Vinum Antimoniale (*not official*).—Tartarated Antimony, 4; boiling Distilled Water, 40; Sherry to make 1,000; Strength, 0.4 per cent.

This preparation is prescribed in canine practice as an expectorant in the early stages of bronchitis in doses of from 10 to 20 minims.

ARSENICUM.

Arseni Trioxidum (Arsen. Trioxid.).—Arsenious Anhydride; As_2O_3 ; Arsenious Acid; White Arsenic.

Source.—Obtained by roasting certain arsenical ores.

Characters.—A heavy white powder; or stratified opaque, white porcelain-like masses. *Solubility.*—1 in 65 of water, yielding an

odourless, tasteless, faintly acid solution; 1 in 8 of glycerin. Volatilized at 204.5° C. *Incompatibles*.—Salts of iron and magnesium; lime-water. *Impurities*.—Lead, cadmium, antimony, tin; and sulphides.

Doses.—Horses and cattle, grs. ii. to grs. viii.; sheep and pigs, gr. $\frac{1}{2}$ to gr. $\frac{3}{4}$; dogs, gr. $\frac{1}{10}$ to $\frac{1}{20}$ —repeated twice daily and combined with other agents in the form of powders administered in the food.

Liquor Arsenicalis (Liq. Arsen.).—‘Fowler’s Solution.’ Contains 1 per cent. arseni trioxidum.

Characters.—A clear colourless liquid; odourless; taste slightly saline; neutral in reaction to litmus.

Doses.—Horses and cattle, $\frac{3}{32}$ ss. to $\frac{3}{16}$ i.; dogs, $\frac{1}{16}$ ii. to $\frac{1}{16}$ viii.

Sodium Aminarsonas.—Atoxyl (*not official*); $C_6H_7NAsO_3Na \cdot 4H_2O$. A white, crystalline, odourless powder; taste saline. Soluble in water.

Doses.—For horses, by subcutaneous injection, grs. vii. to grs. x.; for foals, grs. iii. to grs. v.—gradually increasing the doses.

Atoxyl is said to have only one-fortieth the toxicity of arsenious acid.

Sodium Cacodylas (*not official*) contains 61.8 per cent. of arsenic, but is much less poisonous. It is conveniently given hypodermically.

Doses.—Horses, $\frac{3}{32}$ ss. to $\frac{3}{16}$ i.; dogs, gr. i. to gr. iii.

‘**Salvarsan**’ (*not official*).—Dihydroxydiamino-Arsenobenzene, Arsenobenzol, Kharsivan, Arsenobillon, Ehrlich-Hata ‘606’; $H_2N(OH)C_6H_4As = AsC_6H_3(OH)NH_2$. A pale-yellow powder, soluble in water, with acid reaction. The conversion of atoxyl into Salvarsan is a process protected by patents, but consists in the reduction of atoxyl and the combination of two of its molecules to form trivalent dihydroxydiaminoarsenobenzene.

Galyl (*not official*).—‘Tetraoxydiphosphoamino-Diarsenobenzene’; a yellow powder, easily soluble in water.

‘**Neoarsphenamina**’ (Neoarsphenamin).—Neosalvarsan, Novarsenobenzol, Neokharsivan, Novarsenobillon, ‘914.’ A yellowish powder, easily soluble in water, with neutral reaction.

Sulpharsenamina (Sulpharsenamin).—Sulpharsenamin; a yellow powder, soluble in water.

ARSENOBENZOL (Salvarsan), NOVARSENOENZOL, and GALYL have been found of specific value in the treatment of syphilis. They have been used in the treatment of blackhead in turkeys with considerable success.

ACTIONS.—*Externally*, arsenic is a powerful caustic and escharotic. It does not precipitate proteins and its caustic effect is due to its toxic action on living cells. In dilute solutions it is a parasiticide.

Arsenic has been used extensively in the manufacture of sheep-scab dips. In Great Britain these dips require to be approved by the Ministry of Agriculture and Fisheries. Sodium arsenite is used in the preparation of anti-tick dips in South Africa in concentrations of 0.1 to 0.3 per cent. according to the frequency

of dipping, a less concentration being necessary when the interval between the dippings is shorter.

Internally, in medicinal doses arsenic is a tonic and alterative. It stimulates the gastric mucosa, improves digestion, and increases the appetite. It diminishes oxidation, and increases the formation of fat. It is eliminated from the body chiefly in the fæces and urine. A considerable quantity is retained and is distributed through various organs, principally the liver. Arsenic is believed to influence favourably the nutrition of the skin. It is a valuable hæmatinic, although its action in this respect is not understood.

Arsenic possesses anthelmintic properties.

Administered in gradually increasing doses, a tolerance to the drug is acquired. This effect is probably due to its rendering the intestinal epithelium less capable of absorption, for if arsenic be given regularly in a form in which it is very readily absorbed it acts as a cumulative poison.

TOXIC ACTIONS.—Arsenic is an irritant poison, producing in all animals gastro-enteritis. The rapidity of its action depends on the solubility of the agent, the quantity of food in the stomach, and on the susceptibility of the individual to the effects of the drug.

Acute gastritis may follow the application of arsenic as a caustic dressing to malignant tumours. This is apparently due to the excretion of the drug into the stomach. Arsenic differs from most corrosive poisons in that it does not precipitate proteins and exhibits a definite latent period before its action becomes apparent; most corrosive poisons produce their effect immediately.

In the horse the symptoms observed are violent purging, severe colicky pains, tenesmus, staggering gait, cold extremities, a weak, irregular, thready pulse, death occurring after a variable period. The toxic dose for the horse presents great variation. In some instances 1-drachm doses have produced no effects, while in others smaller amounts have caused nausea, colic, and purging. One case is recorded in which 30 grains given in a solution of carbonate of potash caused death in four days. If the stomach be empty, the toxic actions may be manifested with great rapidity, and death occur within an hour.

Cases of chronic arsenical poisoning have occurred from contamination of the pastures in the neighbourhood of copper-smelting works. The symptoms observed were swelling of the joints, emaciation, dyspepsia, thirst, and distress on exertion.

Cattle are less susceptible than horses to the toxic actions of arsenic. They tolerate larger amounts, and in consequence of

the physiological peculiarities of their digestive system absorption is slow. From 4 to 8 drachms are stated to produce poisonous effects.

In sheep many cases of arsenical poisoning are recorded from the careless use of sheep-dips containing this agent. Arsenic in dilute solutions is not absorbed through the healthy skin, but poisoning not infrequently occurs by allowing sheep access to pasture contaminated by the drippings from the fleeces of dipped sheep. The symptoms observed are: Dulness, nausea, frothing at the mouth, colicky pains, accelerated respirations; in some instances death occurs very rapidly. In accordance with law all sheep-dips used in this country must be approved by the Ministry of Agriculture, and in the use of arsenical dips it is essential that the bath mixture be prepared according to the instructions of the manufacturer of the particular preparation employed. The sheep should be confined in an empty yard for a proper interval after dipping, and should not be returned to the pastures until their fleeces have partially dried.

The dog is very susceptible to the action of arsenic, the toxic dose being from 2 to 5 grains. The symptoms evinced are: Nausea, vomiting, abdominal pain, purging with dark-coloured evacuations, prostration, quick, wiry pulse, soon becoming thready; death is preceded by convulsions. Moderate doses frequently repeated are said to prove more toxic than larger doses given at longer intervals.

If the drug be given in medicinal doses for a prolonged period, redness and swelling of the conjunctiva, an cedematous condition of the eyelids, catarrh of the nasal and pharyngeal mucosæ, and gastric and intestinal irritation may be observed.

The post-mortem appearances of arsenical poisoning vary according to the severity of the case. In the horse the villous portion of the stomach is intensely inflamed, and may be eroded if the poison has been taken in the form of powder. The small and large intestines are acutely inflamed. In cases in which the drug has been continued for some time, fatty degeneration of the liver and other organs is observed, and the carcase may resist decomposition to a remarkable extent.

Arsenical poisoning in horses has resulted from the administration of the drug by attendants, who do so with the object of improving the 'condition' of the animals. In the dog poisoning may occur from the careless use of rat-poisons and vermin-killers containing arsenic.

ANTIDOTES.—In the dog, if treatment can be adopted immediately the stomach should be emptied by the use of emetics, then washed out. Moist ferric hydroxide is the chemical anti-

dote. This can be prepared in various ways. In cases of emergency a solution of ammonia may be added to the strong solution of ferric chloride; or carbonate of soda may be added to this preparation of iron. The mixture is filtered through muslin (a handkerchief may be used in emergency), and the precipitate, after being washed, is administered in large quantities in warm water at intervals of ten minutes (see p. 141).

Another suitable antidote is prepared by mixing 3 parts of solution of perchloride of iron with 17 parts of water, and adding to this, when the antidote is required, 1 part of calcined magnesia in 17 parts of water. For the dog, $\frac{1}{2}$ ounce should be administered every five or ten minutes; for the horse, 8 or 10 ounces. These antidotes should be given freshly prepared, and in amounts equivalent to at least twelve times the probable quantity of the poison that has been taken. They convert the arsenic into an insoluble arsenite.

Dialyzed iron is also an efficient antidote. In the absence of iron preparations, hydrated magnesia, obtained by precipitating a solution of sulphate of magnesia with caustic potash, may be employed.

As mechanical antidotes, oils, demulcents, milk, white of egg, or lime-water, should be administered in large amounts.

Hypodermic injections of morphine are indicated to retard absorption and relieve pain.

In chronic arsenical poisoning, oleaginous laxatives, tonics, and occasional diuretics, should be prescribed.

MEDICINAL USES.—*Externally*, arsenic is chiefly used in the preparation of sheep-dips for the treatment of scabies. The following is a safe dip: Take 2 pounds of arsenious acid, 2 pounds of carbonate of potash, 2 pounds of sublimed sulphur, and 4 pounds of soft soap; dissolve in 10 gallons of boiling water, and add cold water to make 100 gallons. This will be sufficient to dip about 100 sheep.

Because of its penetrative powers arsenic should not be used as a caustic; the conditions in which its escharotic properties were at one time commonly employed are now treated by surgical methods.

Internally, in cases in which diarrhoea occurs shortly after food has been taken, this depending on imperfect digestion in the stomach, small doses of liquor arsenicalis, administered *before* feeding, prove useful, the arsenic probably acting as a gastric tonic.

In nervous affections, such as chorea and epilepsy in dogs, arsenic is prescribed in combination with nervine tonics, but in these conditions it is of doubtful value.

In spasmodic asthma in dogs, and in the condition known as 'broken wind' in horses, arsenic is a valuable palliative remedy, attention being directed at the same time to dietetic treatment. It is also useful in cases of chronic cough, but its beneficial effects in these affections may be ascribed to its action as a general alterative.

In conditions of anæmia and general debility it is prescribed in combination with preparations of iron.

As an alterative, with a special action on the skin, it is employed in various skin affections such as chronic eczema. It should not be prescribed in the acute stage of eczema, and is contra-indicated in cases accompanied by gastric irritability.

Arsenic is commonly used as a vermicide for the horse.

The LIQUOR ARSENICALIS may be given either with the food or immediately after feeding, in order to avoid irritation of the gastric mucosa. When arsenic is continued in medicinal doses, symptoms of chronic poisoning may appear. It is important to recognize these, as their advent is an indication to diminish or cease administration.

In prescribing arsenic, it is always advisable to commence with small doses, and gradually to increase these as the tissues become accustomed to the effects of the drug. This precaution is necessary in consequence of individual idiosyncrasies, and also because it is necessary in many instances to push the administration of the drug in order to secure its beneficial effects.

Sodium cacodylate has been used with success in equine influenza, chronic eczema, and especially in certain protozoal diseases. It is given hypodermically every third or fourth day.

Atoxyl is employed in conjunction with arsenious acid in the treatment of surra and other conditions of trypanosomiasis.

Atoxyl has proved valuable as a vermicide in intestinal strongylosis in young horses, administered hypodermically in doses of 10 grains daily. This dose can be carefully increased until, in the cases of heavy draught horses, 1 drachm may be injected daily. This treatment, which has proved very effective against *Cylicostomum* infestations, should be supplemented by daily doses of coarsenic *per os*.

PHOSPHORUS.

Phosphorus (*not official*).—A solid non-metallic element obtained from Calcium Phosphate.

Characters.—A semi-transparent, wax-like solid; luminous in the dark; ignites in the air. Sp. gr. 1.77; melts at 44° C. **Solubility.**—Insoluble in water, 1 in 350 of absolute alcohol, 1 in 80 of olive oil and of ether, 1 in 25 of chloroform, 2 in 1 of carbon disulphide. **Incompatible** with oxidizing agents, sulphur, and caustic alkalis.

Phosphorus itself is not prescribed in veterinary practice, but the HYPOPHOSPHITES of SODIUM and CALCIUM are important alteratives and tonics.

ACTIONS.—Phosphorus is credited with possessing general alterative actions. It has a special action in promoting the development of bone.

MEDICINAL USES.—The hypophosphites of calcium and sodium are prescribed as alteratives and nerve tonics, especially in debility and anæmia in young animals, and in convalescence from acute diseases. The hypophosphite of calcium combined with an emulsion of cod-liver oil is employed in the treatment of rickets.

Phosphorus is now frequently given in the form of GLYCEROPHOSPHATES (p. 177). The SYRUPUS GLYCEROPHOSPHATUM COMPOSITUS (B.P.C.) is a favourite preparation, and contains glycerophosphates of sodium, potassium, calcium, magnesium, and iron, with caffeine, citric acid, and strychnine.

DOSE.—Dogs, \mathfrak{z} i. to \mathfrak{z} ii.

Calcii Hypophosphis.— $\text{Ca}(\text{PH}_2\text{O}_2)_2$ (*not official*).

Source.—Obtained by the interaction of phosphorus, calcium hydroxide and water. $3\text{Ca}(\text{OH})_2 + 2\text{P}_4 + 6\text{H}_2\text{O} = 3\text{Ca}(\text{PH}_2\text{O}_2)_2 + 2\text{PH}_3$.

Characters.—White pearly crystals; taste bitter, nauseous. **Solubility.**—1 in 8 of cold water; insoluble in cold alcohol 90 per cent. **Incompatible** with potassium iodide and oxidizing agents.

Sodii Hypophosphis.— NaPH_2O_2 (*not official*).

Source.—Obtained by the interaction of sodium carbonate and calcium hypophosphite. $\text{Ca}(\text{PH}_2\text{O}_2)_2 + \text{Na}_2\text{CO}_3 = 2\text{NaPH}_2\text{O}_2 + \text{CaCO}_3$.

Characters.—A white, granular, deliquescent salt; taste bitter, nauseous. **Solubility.**—1 in 1 of water; 1 in 30 of alcohol 90 per cent.; insoluble in ether.

Doses.—Calcium hypophosphite and sodium hypophosphite for the horse from \mathfrak{z} i. to \mathfrak{z} ii.; for the dog, grs. iii. to grs. x.

See also SYRUPUS FERRI PHOSPHATIS COMPOSITUS (p. 139) and SYRUPUS CALCII LACTOPHOSPHATIS (p. 125).

TOXIC ACTIONS.—Phosphorus is an irritant corrosive poison, causing in the dog gastro-enteritis, vomiting, intense thirst, and purging. The vomited substance smells of phosphorus and is luminous in the dark. In some cases altered blood is vomited. It is usually a comparatively slow poison, death occurring in two to three days. Partial recovery may ensue; this is followed by symptoms of jaundice, with tenderness over the region of the liver, which is enlarged. Smaller doses, repeated for a few days, cause fatty degeneration in the liver, and to a less extent in muscle, kidneys, and bowel.

Phosphorus is more toxic if taken in a finely divided condition.

The chief source of poisoning in the dog is the accidental ingestion of rat-pastes or vermin-killers, which frequently contain this agent.

ANTIDOTES.—Sulphate of copper in a dose of 3 grains dissolved in water should be administered every five minutes until vomiting is produced. By this means a portion of the poison is vomited, and copper is deposited on what remains, rendering it inert. This agent should be continued in 1-grain doses every quarter of an hour, and combined with morphine if rejected by the stomach. Oil of turpentine is also employed as an antidote. Thirty minims should be administered every half-hour. Fats, oils, and milk should be avoided, as they render phosphorus soluble, but mucilaginous drinks may be freely given.

GROUP IV—THE NON-METALLIC ELEMENTS.

CHLORUM.

Chlorine gas is not official.

ACTIONS AND USES.—Chlorine is a powerful disinfectant and deodorant and acts by forming hypochlorous acid, which attacks the amino groups of the proteins to form chloramines, which are themselves antiseptic. The chlorine antiseptics are also capable of destroying bacterial toxins.

Eupad (*not official*)—

PREPARED by mixing equal parts of bleaching powder (p. 124) and boric acid.

Eusol (*not official*)—

Is a filtered solution of 25 grammes of eupad in a litre of water (equivalent to about 1 ounce of eupad in 2 pints of water). It contains 0.27 per cent. of hypochlorous acid.

After thorough trituration the mixture should be allowed to stand for two or three hours before it is filtered through a coarse paper.

Eusol is now extensively used in surgery, and is one of the most satisfactory general antiseptics. It is only slightly irritant to the tissues, is non-toxic, assists the separation of necrotic tissue, and promotes rapid cleansing and healing of the wound.

Liquor Sodæ Chlorinatæ Chirurgicæ (Liq. Sod. Chlorinat. Chir.)
—DAKIN'S SOLUTION.

Prepared from chlorinated lime, sodium carbonate, and boric acid in distilled water. Contains between 0.5 per cent. and 0.55 per cent. of available chlorine.

This is an isotonic solution which closely resembles eusol in its action as an antiseptic, but it is much less stable than eusol, and requires to be freshly prepared and protected from light.

IODUM.

Iodum (Iod.).—Iodine; a solid non-metallic element.

Source.—Obtained from native iodides and iodates; and from kelp, the ashes of seaweeds.

Characters.—Rhombic prisms or octahedrons of the trimetric system, of dark colour, metallic lustre and peculiar odour. Yields a violet-coloured vapour when heated. **Solubility.**—1 in 5,000 of water; freely in alcohol 90 per cent., chloroform, ether, carbon disulphide, or solution of potassium iodide. **Incompatibles.**—Ammonia, metallic salts, mineral acids, alkaloids. **Impurities.**—Iodine cyanide, subliming as colourless prisms; iron, not volatile; water, as moisture.

Doses.—Horses, grs. xv. to 3ss.; cattle, 3ss. to ʒi.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$. Administered in bolus or pill.

Liquor Iodi Fortis (Liq. Iod. Fort.).—Strong Tincture of Iodine. Iodine, 10; Potassium Iodide, 6; Water, 10; Alcohol (90 per cent.) to 100; Strength, 10 per cent.

Liquor Iodi Mitis (Liq. Iod. Mit.).—Weak Tincture of Iodine. Iodine, 2·5; Potassium Iodide, 1·5; Distilled Water, 2·5; Alcohol (90 per cent.) to 100; 1 in 40.

Liquor Iodi Simplex (Liq. Iod. Simp.).—Simple Solution of Iodine. Iodine, 9; Alcohol (95 per cent.) sufficient to produce 100.

Unguentum Iodi (not official).—Iodine, 4; Potassium Iodide, 4; Glycerin, 12; Prepared Lard, 80; 1 in 25.

For horses, there is used an ointment prepared with 1 part each of iodine and potassium iodide in 8 parts of lanolin, the last being rendered sufficiently soft by admixture with soft paraffin.

Liquor Iodi, Lugol's Solution (not official).—Iodine, 2; Potassium Iodide, 3; Water, 40.

'TINCTURA IODI DECOLORATA'—Decolorized Tincture of Iodine (*not official*).

Iodine, 2·85; alcohol (90 per cent.), 27·5; strong solution of ammonia, 6·25; and alcohol (90 per cent.), q.s. to 100. The solution contains ammonium iodide and iodate; it is colourless, and does not stain the skin.

Potassii Iodidum (Pot. Iod.).—Potassium Iodide; KI.

Source.—Obtained by (1) dissolving a slight excess of iodine in a strong solution of potassium hydroxide, and evaporating to dryness; $6\text{KOH} + 3\text{I}_2 = 5\text{KI} + \text{KIO}_3 + 3\text{H}_2\text{O}$. (2) Mixing the residue with charcoal and fusing, thus converting the iodate, which was formed with the iodide, into iodide: $2\text{KIO}_3 + 6\text{C} = 2\text{KI} + 6\text{CO}$. (3) Purifying.

Characters.—Colourless, opaque, cubic crystals; taste saline, bitter; reaction feebly alkaline. **Solubility.**—In less than 1 of water; 1 in 12 of alcohol 90 per cent. **Incompatibles.**—Spiritus ætheris nitrosi, potassium chlorate, bismuth subnitrate, diluted nitrohydrochloric acid, ferric chloride solutions, and liquor strychninæ hydrochloridi. **Impurities.**—Iodates, detected by blue colour with tartaric acid and starch; bromides, cyanides, nitrates; many metals.

Doses.—Horses, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; sheep and pigs, grs. xx. to grs. xl.; dogs, grs. iii. to grs. x. Administered in solution twice daily, or in the food.

Sodii Iodidum (Sod. Iod.).—Sodium Iodide; NaI.

Source.—Prepared like potassium iodide, sodium hydroxide being used in place of potassium hydroxide, and the salt crystallized at not less than 20°C.

Characters.—A white crystalline, deliquescent powder, taste saline, bitter. **Solubility.**—Readily in less than 1 of water; 1 in 3 of alcohol 90 per cent. **Impurities.**—As of potassium iodide.

Doses.—Similar to those of potassium iodide. (See also p. 164.)

Linimentum Potassii Iodidi cum Sapone (not official).—Potassium Iodide, 15; Curd Soap, 20; Glycerin, 10; Oil of Lemon, 1; Water, 100.

This liniment does not stain or irritate the skin. It is used in canine practice as an absorbent application.

GENERAL ACTIONS OF IODINE AND ITS PREPARATIONS.

Externally, iodine is antiseptic, disinfectant, resolvent, and parasiticide. Repeated applications to the skin are irritant and vesicant.

Internally, iodine is rapidly excreted by the kidneys, by mucous secretions, particularly those of the respiratory tract, and to a much less extent by the sweat, saliva, milk, and bile. During its excretion it acts as a saline diuretic, and by stimulating the bronchial mucous glands it liquefies their secretion and is expectorant. Iodides stimulate the secretion of the thyroid gland and so increase metabolism. Iodine and iodides exert a specific action on the *Actinobacillus*, the cause of 'wooden tongue' in cattle, but their action on *Actinomyces*, the cause of lesions involving the mandible in cattle, is much less effective.

Toxic Actions.—In toxic doses iodine is an irritant, causing diarrhoea and loss of appetite. Single full doses usually produce no toxic symptoms in horses and cattle. This may be accounted for by the large amount of starch in the food of herbivora, the insoluble iodide of starch being formed.

If the drug be given in repeated full doses 'iodism' may result. This is evinced by loss of appetite, dyspepsia, an irritable catarrhal condition of the mucous membrane of the nasal passages, pharynx, eyes and stomach, abstinence from water, emaciation, and a dry, scurfy condition of the skin.

ANTIDOTE.—Starch converts the iodine into the insoluble iodide of starch which must be removed by aperients.

MEDICINAL USES.—**Externally,** for the reduction of bursal enlargements, a combination of iodine ($12\frac{1}{2}$ per cent.), Stockholm tar, soft soap, and lanolin proves useful.

Iodine, either in the form of the ointment or the weak liquor, is an excellent application in ringworm, and in the squamous type of demodectic mange.

The weak liquor is largely used for the purpose of sterilizing the skin prior to the performance of surgical operations. The skin, which should be dry, is painted with the liquor and the application is repeated after an interval of five minutes. The adoption of this procedure has rendered complicated and troublesome methods of skin disinfection unnecessary.

A single application of the weak liquor is an effective method of sterilizing newly inflicted wounds, but its application as a wound dressing is accompanied by much pain, and its caustic action may cause considerable destruction of tissue, and seriously retard healing if applied frequently.

Internally, in canine practice the iodide of potassium proves useful in chronic bronchitis, by rendering the secretion less viscid and facilitating expectoration.

In actinobacillosis in cattle, potassium iodide in full doses possesses specific curative action; 2 drachms dissolved in a pint of water are given twice daily for eight to ten days. The case then usually shows marked improvement, but in exceptional instances a prolonged course of treatment is necessary. Sodium iodide in doses of ʒi. in $\frac{1}{2}$ to 1 pint of water, administered intravenously and repeated in a week to ten days, has elicited curative response in a number of resistant cases.

In 'scirrhus cord,' and in botriomycosis, a prolonged course of potassium iodide occasionally proves of value.

In lymphangitis the administration of potassium iodide was supposed to assist in removing the fibrous deposit in the limb.

In canine practice a long course of potassium iodide is frequently prescribed in the treatment of the paraplegia resulting from pachymeningitis, but is of very doubtful value.

Potassium iodide is an antidote in chronic lead and mercury poisoning. It is believed to dissolve the albuminates of these metals, and so to render them capable of being excreted.

Iodine vapour, produced by heating the crystals, is occasionally used as an inhalation in the treatment of parasitic bronchitis in calves, but other methods of treatment are preferable.

BROMUM.

A liquid element obtained from sea-water and from some saline springs.

Potassii Bromidum (Pot. Brom.).—Potassium Bromide; KBr.

Source.—Obtained by the interaction of ferrous bromide with K_2CO_3 . $\text{FeBr}_2 + \text{K}_2\text{CO}_3 = 2\text{KBr} + \text{FeCO}_3$.

Characters.—Colourless cubical crystals, without odour, of a pungent saline taste. *Solubility*.—1 in 2 of water. *Incompatible* with mineral acids, mercury, and silver salts, strychnine and sweet spirit of nitre. *Impurities*.—Carbonates, bromates, iodates, iodides, sulphates; other metals.

Doses.—Horses, ʒss. to ʒi. ; dogs, grs. x. to grs. xx. Administered in solution.

Sodii Bromidum (Sod. Brom.).—Sodium Bromide; NaBr.

Source.—May be prepared as potassium bromide, substituting sodium carbonate for potassium carbonate.

Characters.—Small white cubic crystals, somewhat deliquescent, inodorous, with saline taste. *Solubility*.—1 in 1.5 of water; 1 in 16 of alcohol 90 per cent. *Impurities* and *Incompatibles* as of potassium bromide.

Doses.—Similar to those of potassium bromide.

Ammonii Bromidum.—Ammonium Bromide; NH_4Br (*not official*).

Source.—Is formed by neutralizing hydrobromic acid with solution of ammonia. $\text{HBr} + \text{NH}_4\text{OH} = \text{NH}_4\text{Br} + \text{H}_2\text{O}$.

Characters.—Small colourless crystals, with a pungent saline taste. *Solubility*.—1 in 1.5 of water; 1 in 13 of alcohol 90 per cent. Volatilized by heat. *Impurities*.—Lead, iron, iodides, bromates, nitrates.

Doses.—Similar to those of potassium bromide.

ACTIONS.—Bromides lessen the activity of the nervous system, and act as sedatives to the brain and spinal cord. In full doses they are soporifics and hypnotics. They depress the processes by which functional activity of the brain is maintained, and also depress reflex excitability of the spinal cord.

TOXIC ACTIONS.—Toxic doses are cardiac depressants, and also produce muscular weakness, an unsteady gait, impaired reflex movements, and general listlessness. Full continued doses may induce 'bromism,' which is evidenced by cerebral depression, feebleness, anæmia, and in some instances the appearance of an eruption resembling acne. These symptoms, however, are very rarely encountered in veterinary practice.

MEDICINAL USES.—Potassium bromide is the salt of bromine usually employed in equine practice. Sodium bromide is less depressant and better tolerated by the stomach, and is therefore preferred in canine practice in cases in which debility and gastric irritation are present.

The three salts of bromine are often combined, or they may be prescribed with advantage in combination with chloral hydrate. In epileptic convulsions in dogs the bromides lessen excitability, and are given in full doses. In chorea they act as palliatives when the symptoms are acute. They are of little or no value in the convulsions associated with distemper, and while they prove useful in the treatment of puerperal eclampsia in the bitch, this condition is now rationally treated by calcium injection.

Although antagonistic to the actions of strychnine, bromide of potassium is not a reliable antidote in strychnine poisoning.

In the earlier stages of pericarditis, and in conditions in which cardiac palpitation is a prominent symptom, the bromides prove useful.

SULPHUR.

Sulphur Sublimatum (Sulphur Sublim.).—Sublimed Sulphur; Flowers of Sulphur.

Source.—Prepared from native sulphur or sulphides by sublimation.

Characters.—A fine, greenish-yellow, gritty powder, without taste or odour; faintly acid. Entirely volatilized by heat. *Solubility*.—Insoluble in water; soluble in carbon disulphide, fixed oils, and turpentine, with heat. *Impurities*.—Sulphurous and sulphuric acids; arsenium sulphide.

Doses.—As a laxative: horses, \mathfrak{z} i. to \mathfrak{z} ii.; cattle, \mathfrak{z} iii. to \mathfrak{z} iv.; sheep and pigs, \mathfrak{z} ss. to \mathfrak{z} i.; dogs, grs. xv. to \mathfrak{z} ii. As an alterative, one-fourth of these doses is prescribed.

Sulphur Præcipitatum (Sulphur Præcip.).—Precipitated Sulphur; Milk of Sulphur.

Source.—Made by (1) boiling sulphur and lime in water; (2) precipitating the filtrate with hydrochloric acid, washing and drying. (1) $6\text{S}_2 + 3\text{Ca}(\text{OH})_2 = 2\text{CaS}_3 + \text{CaS}_2\text{O}_3 + 3\text{H}_2\text{O}$. (2) $2\text{CaS}_3 + \text{CaS}_2\text{O}_3 + 6\text{HCl} = 3\text{CaCl}_2 + 6\text{S}_2 + 3\text{H}_2\text{O}$.

Characters.—A greyish-yellow soft powder. *Impurities*.—Calcium sulphate, H_2SO_4 being used instead of HCl: detected by grittiness and as crystals.

Doses.—Similar to those of sublimed sulphur.

Unguentum Sulphuris (Ung. Sulphur.).—Sublimed Sulphur, 1; Unguentum Simplex, 9.

' LOTIO SULPHURIS ' (not official)—

Precipitated sulphur, $\frac{1}{2}$ ounce; glycerin, 2 drachms; alcohol, 1 ounce; lime-water, 3 ounces; rose-water, 3 ounces.

' LOTIO CALCH SULPHURATI ' (not official)—

Sublimed sulphur, 8 ounces; quicklime, 1 pound; water, 4 pints. Simmer until the mixture becomes of a golden-yellow colour, and filter after three days.

Potassa Sulphurata (Potass. Sulphur.).—Sulphurated Potash; 'Liver of Sulphur'; a mixture of Salts of Potassium, chiefly Sulphides.

Source.—Made by fusing sublimed sulphur 5 with potassium carbonate 10.

Characters.—Solid greenish-yellow fragments, liver-brown when recently broken; alkaline; acrid to the taste; soluble in water (solution yellowish, opalescent, smelling of H_2S , which is evolved on addition of HCl). Contains 42 to 45 per cent. of sulphur.

ACTIONS.—*Externally*, the precipitated sulphur, in consequence of its finely divided condition, is more active than the sublimed

form and is preferred for the preparation of ointments and liniments in canine practice. When sulphur is applied to the skin a small proportion of the agent is converted by the cutaneous secretions into sulphides. This process is slow and continuous, and a mild degree of vascular stimulation of the skin is produced. Sulphur is a powerful acaricide, but if applied too frequently severe irritation of the skin results.

Internally, sulphur passes through the stomach unaltered. In the small bowel a small proportion is converted into alkaline sulphide, which acts as a stimulant to the intestines, renders their contents soft, and thus has a laxative effect. The major part of the drug is excreted in the *fæces* unchanged. A small amount is absorbed as alkaline sulphide, is oxidized in the body, and excreted chiefly in the form of sulphate in the urine. Small amounts are also excreted from the lungs, and traces of sulphur compounds by the skin. In very large doses sulphur produces irritant effects, evidenced by colicky pains and purging; in some recorded instances gastro-enteritis was produced.

MEDICINAL USES.—*Externally*, sulphur is used as a parasiticide in the treatment of mange in all species of animals. Various formulæ are employed; many of these contain an alkali such as potassium carbonate, which is believed to increase the formation of sulphuretted hydrogen and sulphides, thus increasing the activity of the parasiticide action. The alkali also enables the sulphur to penetrate the affected parts by softening and removing crusts and scales on the skin.

For the horse, 2 parts of sublimed sulphur, 1 part of potassium carbonate, 1 part oil of tar, and 8 parts of sperm-oil, form a time-honoured dressing. The affected parts are thoroughly washed with soft-soap and warm water; when the skin is dry the dressing is applied and allowed to remain on the skin for two days; it is then washed off and reapplied. This dressing has now been largely replaced by simpler and less irritant applications.

The **UNGUENTUM SULPHURIS** is a suitable application for mange in the dog. For the small breeds of house dogs the **LOTIO SULPHURIS** is convenient, as is also a liniment composed of precipitated sulphur, 1 part; zinc oxide, 1 part; olive-oil, 8 parts. Sulphur is sometimes applied as a skin stimulant in chronic eczematous conditions in dogs.

The **LOTIO CALCII SULPHURATI** is recommended as a mange dressing for the horse; it is also employed as a sheep-dip. This preparation may also be used in the treatment of mange in the dog.

Sulphurous acid gas, prepared by burning sulphur mixed with $\frac{1}{10}$ part of charcoal, may be employed as a disinfectant for

stables and farm buildings, but unless large quantities are used, and precautions taken to close all outlets, this method does not prove effectual. At one time it was used as an inhalation in the treatment of parasitic bronchitis in calves and lambs, but it proved not only useless but dangerous for this purpose.

POTASSA SULPHURATA is employed chiefly as a parasiticide in mange and pediculosis in dogs. For this purpose it may be used as a bath, $\frac{3i}{}$ of the agent being dissolved in C. $\frac{iii}{}$ of warm water.

Preparations of sulphur should be applied to the skin with caution, as they may give rise to considerable irritation, if not to dermatitis.

Internally, as an alterative, sulphur is prescribed in affections of the skin, and it forms a favourite constituent of alterative powders. It may be combined with other alteratives, and is readily taken in the food. In canine practice it is a useful laxative agent, and is largely employed for this purpose.

COLLOIDAL PREPARATIONS OR COLLOSOLS.

Many elements and their salts which exist ordinarily in the form of crystalloids can be converted into the colloidal state—*i.e.*, they exist as finely divided, amorphous, and practically non-diffusible particles.

Since many of the tissue reactions are colloidal in character, and since it is probable that most of the tissue materials exist in a colloid state, it is conceivable that colloid drugs, isotonic and isomorphic with the body fluids and tissues, are more likely to be tolerated than would be the same drugs in the crystalline form.

This idea has brought about the employment of colloids in therapeutics, but since colloids are capable of decomposition by electrolytes, it is necessary to administer them in a semi-viscous material like gelatin or albumin in order to prevent their electrolytic destruction in the tissues.

Colloids are now used fairly extensively in medicine, but while marked success is claimed for their use, further experience is necessary before their therapeutic value can be assessed.

Colloidal preparations of the following, among other substances, are now prepared commercially:

Lime.	Bismuth.	Manganese.	Zinc.	Sulphur.
Antimony.	Copper.	Mercury.	Bromine.	Quinine.
Arsenic.	Iron.	Silver.	Iodine.	

GROUP V—ACIDS.

GENERAL ACTIONS OF ACIDS.

For convenience of description, the acids employed in veterinary practice may be arranged according to their inorganic or organic character.

Some of the organic acids (such as salicylic and prussic acids) have actions and uses which are but slightly connected with their properties as acids; they will not, therefore, receive notice in this section, but will be considered under separate headings.

The mineral acids—*e.g.*, sulphuric, nitric, and hydrochloric—when undiluted, are caustics and escharotics, acting by coagulating albumin, which is later dissolved (nitric acid is an exception, see p. 170); internally they are violent corrosive and irritant poisons.

Administered in the dilute form and in medicinal doses, acids are reflex sialagogues. They do not affect the secretion of gastric juice, but prove useful in cases of dyspepsia when the gastric acid is deficient in amount, since they indirectly increase the pancreatic secretion. Acids are quickly absorbed and converted into salts. They render the blood less alkaline, an effect which is more marked in herbivora. The urine is rendered more acid by the formation of acid salts, and diuresis is also induced.

All acids should be given properly diluted with water, and should not be continued for prolonged periods.

INORGANIC ACIDS.

Acidum Sulphuricum (Acid. Sulph.).—Sulphuric Acid; H_2SO_4 ; Hydrogen Sulphate, 95 per cent. by weight, in Water.

Source.—Obtained by the combustion of sulphur or pyrites, and the oxidation by nitrous fumes, and hydration by aqueous vapour, of the resulting sulphur dioxide.

Characters.—A colourless, corrosive, oily-looking, intensely acid liquid. Sp. gr. 1.841. Soluble sulphates give a heavy white insoluble precipitate with BaCl_2 . *Incompatible* with alkalies, carbonates, salts of lead, silver, barium, calcium, strontium. **Impurities.**—Nitric and other acids; selenium, ammonium, iron, copper, lead, arsenium and carbonaceous matter.

Acidum Sulphuricum Dilutum (Acid. Sulph. Dil.).—Diluted Sulphuric Acid; Sulphuric Acid 11.25 g. in 94 ml. Distilled Water. Contains 10 per cent. of H_2SO_4 . Sp. gr. 1.069.

Doses.—Of the dilute acid: horses, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{ii}$.; cattle, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$.; dogs, $\mathfrak{M}\text{v}$. to $\mathfrak{M}\text{xv}$. Administered freely diluted, in combination with vegetable bitters.

ACTIONS AND USES.—*Externally*, strong sulphuric acid is a powerful caustic and escharotic. It destroys tissue, producing a brown or black eschar or slough.

Internally, it is a corrosive irritant poison, causing erosions in the mucous membrane of the mouth, pharynx, œsophagus, and stomach, death resulting from collapse. In some cases the acute inflammation of the throat produces extensive swelling, with asphyxia as a result.

In the dog, violent emesis occurs, the vomited matter being dark-coloured, and containing shreds of mucous membrane and altered blood.

ANTIDOTES.—Alkaline carbonates, especially those of magnesium; chalk, white of egg, 'carron-oil,' milk, lime-water, demulcent drinks; opiates to relieve pain, and stimulants to prevent collapse.

The strong sulphuric acid is not employed as a medicinal agent.

MEDICINAL USES.—The dilute acid is a tonic and an intestinal astringent. Administered after feeding, it promotes digestion, and is believed to exert an astringent action on the intestinal bloodvessels. In chronic diarrhoea and dysentery it is frequently effective, and may be prescribed in combination with opiates, astringents, and carminatives.

Dilute sulphuric acid is an antidote in chronic lead-poisoning. In pharmacy it is employed as a solvent for quinine sulphate.

Acidum Nitricum (Acid. Nit.).—Nitric Acid; HNO_3 ; Hydrogen Nitrate, 70 per cent. by weight, in Water.

Source.—Prepared by the interaction of sodium nitrate with sulphuric acid.

Characters.—A clear, colourless, intensely acid liquid, emitting corrosive fumes. Sp. gr. 1.42. If a solution of a nitrate be added to H_2SO_4 at the bottom of a test-tube, and solution of FeSO_4 carefully added after cooling, a black-brown ring will be formed at the line of junction of the first two fluids. *Incompatible* with alkalies, carbonates, sulphides and oxidizable substances. **Impurities.**—Sulphates, bromates, iodates; chlorides; lead, copper, arsenium, iron.

Acidum Nitricum Dilutum (not official).—Diluted Nitric Acid; Nitric Acid 15.1 g. in Distilled Water to 100 ml. Contains 10 per cent. of HNO_3 . Sp. gr. 1.057.

Doses.—Of the dilute acid: horses and cattle, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{ii}$.; dogs, $\mathfrak{M}\text{v}$. to $\mathfrak{M}\text{x}$. Administered properly diluted, and combined with aromatic bitters.

ACTIONS AND USES.—*Externally*, strong nitric acid is a caustic and escharotic; it is slower in its action than sulphuric acid; while it coagulates proteins it does not redissolve them, and its action is therefore limited. It stains the skin a yellow or brownish colour, due to the formation of picric acid.

The strong acid is occasionally employed as a caustic for

the removal of warts; but great care is necessary in the application, and serious injuries have resulted when it has been carelessly applied to the skin, especially if close to a joint or on the horse's heel or coronet.

Internally, in toxic amounts it is a corrosive irritant poison, causing in the dog violent vomiting, the vomited matter containing altered blood and shreds of membrane stained yellow. The mouth, throat, and stomach are acutely inflamed.

The ANTIDOTES are similar to those for sulphuric acid.

The strong acid is not used internally. The dilute acid was formerly believed to be a direct cholagogue, but there is little evidence to support this view.

Occasionally the agent is prescribed in cases of dyspepsia characterized by a deficiency of acid in the gastric secretion.

Acidum Hydrochloricum (Acid. Hydrochlor.).—Hydrochloric Acid; Hydrogen Chloride, HCl, 32 per cent. by weight, dissolved in Water.

Source.—Obtained by the interaction of sulphuric acid and sodium chloride, and solution of the fumes in water.

Characters.—A colourless, strongly acid liquid, emitting white pungent fumes. Sp. gr. 1.160. Chlorides give a white curdy precipitate with AgNO_3 , soluble in NH_4OH ; insoluble in HNO_3 . *Incompatible* with alkalis, carbonates, metallic oxides, silver, and lead salts. *Impurities.*—Arsenium, lead, iron, sulphates, sulphites, bromides, and iodides; free chlorine.

Acidum Hydrochloricum Dilutum (Acid. Hydrochlor. Dil.).—Diluted Hydrochloric Acid; Hydrochloric Acid 33 g. in Distilled Water to 100 ml. Contains 10 per cent. of HCl. Sp. gr. 1.048.

Doses.—Of the dilute acid, similar to those of dilute nitric acid.

ACTIONS AND USES.—*Externally*, the strong hydrochloric acid is an active caustic, causing the formation of a white film on the tissues with which it comes in contact; because of its volatile character it diffuses rapidly through the tissues, causing widespread damage.

Hydrochloric acid may be employed as a caustic in the removal of warts, but for this purpose other agents such as the nitrate of silver are preferable. In cases of superficial necrosis of bone, if applied properly diluted, it assists removal of the diseased portion, and thus hastens healing; but surgical measures usually prove more satisfactory.

Internally, in toxic amounts it is an irritant corrosive poison, resembling in its actions the other mineral acids.

The ANTIDOTES are similar to those for the other mineral acids.

Dilute hydrochloric acid is prescribed in dyspepsia, due to a deficiency in the secretion of the natural acid in the stomach. It is usually combined with vegetable tonics and bitters, and administered after feeding.

In some cases of dyspepsia with excessive fermentation of the gastric contents, and associated with an excessive formation in the stomach of organic acids (so-called 'acid dyspepsia'), dilute hydrochloric acid given before feeding may prove beneficial.

In canine typhus the gastric contents are alkaline, and alkaline gastric sedatives are not of value. Dilute hydrochloric acid may act beneficially if treatment be adopted before organic changes occur in the alimentary canal. In cases of foetor oris, accompanied by an accumulation of tartar on the teeth, a wash consisting of dilute hydrochloric acid $\mathfrak{Z}\text{ii.}$ and water $\text{O}\text{i.}$ may be applied to the tongue, gums, and teeth two or three times daily.

Acidum Nitro-hydrochloricum Dilutum (*not official*).—Diluted Nitrohydrochloric Acid; Nitric Acid, $\mathfrak{r}\mathfrak{z}$; Hydrochloric Acid, $\mathfrak{r}\mathfrak{6}$; and Distilled Water, $\mathfrak{100}$. To be made fourteen days before using. It contains free chlorine, and hydrochloric, nitric, and nitrous acids, dissolved in water. Sp. gr. $\mathfrak{1}\cdot\mathfrak{07}$.

Doses.—Of the dilute acid: horses and cattle, $\mathfrak{Z}\text{i.}$ to $\mathfrak{Z}\text{ii.}$; dogs $\mathfrak{M}\text{v.}$ to $\mathfrak{M}\text{x.}$ Administered properly diluted, and combined with aromatic bitters.

ACTIONS AND USES.—Dilute nitro-hydrochloric acid is still employed as a cholagogue, but its action in this respect is doubtful. It is occasionally prescribed in dyspepsia.

Chromii Trioxidum (Chrom. Triox.).—Chromic Anhydride; CrO_3 ; 'Chromic Acid.'

Source.—Produced by the interaction of sulphuric acid and potassium bichromate.

Characters.—Crimson needles, very deliquescent; inodorous; corrosive to the skin. **Solubility.**—Very readily in water and in ether. May explode with glycerin, ether, or alcohol 90 per cent. Mixed with cold alcohol, aldehyde is evolved, and a green residue of chromium oxide remains. **Incompatible** with most organic matters. **Impurity.**—Sulphates.

Liquor Acidi Chromici (*not official*).—Chromic Anhydride, $\mathfrak{25}$ g.; Water to $\mathfrak{100}$ ml.

ACTIONS AND USES.—Chromic acid coagulates albumin and is a penetrating caustic. It is a powerful oxidizing agent, and if applied in a warm concentrated solution, it rapidly destroys tissue. It is occasionally employed in the treatment of that affection of the horse's foot known as canker, and it should be carefully applied with a glass rod. Chromic acid is not prescribed for internal use.

Potassii Bichromas (*not official*). — Potassium Bichromate; $\text{K}_2\text{CrO}_4, \text{CrO}_3$.

Source.—Produced by (1) roasting chrome ironstone ($\text{FeO}, \text{Cr}_2\text{O}_3$) with lime in presence of air; (2) treating the product with a potassium salt, by which yellow chromate of potassium is obtained,

K_2CrO_4 ; (3) subsequently, with an acid, *e.g.*, sulphuric acid, this yields red or potassium bichromate.

Characters.—Large orange-red crystals. *Solubility*.—1 in 10 of water; solution acid.

Potassium bichromate resembles chromic acid in its actions. As a saturated solution it is occasionally employed as a caustic.

Acidum Boricum (Acid. Boric.).—Boric Acid; Boracic Acid; H_3BO_3 .

Source.—By the interaction of sulphuric acid and borax.

Characters.—White pearly lamellar crystals, unctuous to the touch, odourless; taste slightly acid and bitter. A weak acid. *Solubility*.—1 in 25 of water; 1 in 4 of glycerin; 1 in 30 of alcohol 90 per cent. A solution in alcohol burns with a green flame. *Impurities*.—Copper, iron, calcium, magnesium; chlorides and sulphates.

Doses.—Horses and cattle, \mathfrak{z} ii. to \mathfrak{z} iv.; dogs, grs. v. to grs. xv.

Glycerinum Acidi Borici (Glycer. Acid. Boric.).—Boric Acid, 31; Glycerin to 100.

Unguentum Acidi Borici (Ung. Acid. Boric.).—Boric Acid, 10; Paraffin Ointment, white, 90.

BORIC LINT—

Lint containing 50 per cent. of boric acid. It should not be scaly.

BORIC GAUZE—

Gauze containing 20 per cent. of boric acid.

BORIC WOOL—

Wool containing from 20 to 50 per cent. of boric acid.

Borax (Borax).—Purified Borax; Biborate of Sodium; Sodium Pyroborate; $Na_2B_4O_7 \cdot 10H_2O$.

Source.—Native. Also made by boiling native calcium borate with a solution of sodium carbonate.

Characters.—Transparent, colourless crystals, sometimes slightly effloresced; taste saline; weakly alkaline. *Solubility*.—1 in 25 of water; 1 in 1 of glycerin; insoluble in alcohol 90 per cent. *Incompatible* with mineral acids, metallic salts, mucilage of acacia, cocaine; borax is decomposed by glycerin into boric acid and glyceryl borate.

Glycerinum Boracis (Glycer. Borac.).—Purified Borax, 3; Glycerin, 22; triturated. Reaction *acid* (*see above*).

Doses.—Horses, \mathfrak{z} i.; dogs, \mathfrak{z} ss. to \mathfrak{z} i.

Mel Boracis (Mel Borac.).—Purified Borax, 10; Glycerin, 5; Purified Honey, 85; mixed.

Doses.—Similar to those of glycerinum boracis.

ACTIONS AND USES.—Boric acid and borax are similar in their actions, but the latter possesses in addition slightly astringent properties.

Externally, boric acid is a non-irritant and practically non-poisonous antiseptic. A 3 per cent. solution lessens irritability

of the skin, while a 4 per cent. solution exerts distinct antiseptic effects in wounds. It is used as an antiseptic dressing for simple wounds in the horse, and is especially useful for this purpose in canine practice.

Boric lint forms an excellent dressing for punctured wounds, two or three folds of this material being soaked in a hot solution of boric acid and applied to the part, which is then covered with oiled silk, wool, and a bandage. This forms an antiseptic poultice, and is also applicable to other conditions in which moist dressings are indicated. The lint can be kept moist by pouring in a further supply of a warm boric solution between the dressing and the part at intervals. In the dry dressing of wounds boric acid is largely employed. For this purpose it may be combined with oxide of zinc and starch.

In unhealthy wounds and ulcerated surfaces, boric acid in combination with iodoform and oxide of zinc forms a useful application when used in the following proportions: Iodoform, 1 part; boric acid, 2 parts; and zinc oxide, 2 parts. This also forms an excellent dressing for otorrhœa in the dog.

In catarrhal and purulent conjunctivitis, a lotion consisting of boric acid, 4 grains, and distilled water, 1 ounce, lessens irritability and reduces the discharge.

Pessaries containing boracic acid are of especial value in the treatment of septic metritis in cows. The pessaries may be readily prepared by filling large gelatin capsules with the agent. In cases of retained placenta in cows, in which it is considered inadvisable to remove the membranes forcibly, the insertion of such a pessary will effectively prevent their decomposition.

Boric ointment, either alone or combined with other agents, is useful in erythema and eczematous conditions of the skin in dogs.

GLYCERINUM ACIDI BORACI is recommended as a dressing for 'strike' in sheep. It is said to destroy the maggots, to remove the odour and so prevent further 'strike.'

Toxic symptoms such as occasionally occur in human practice, resulting from the absorption of boric dressings, are not observed in animals.

Boric acid is a solvent for calcium gluconate, and enters into combination with this salt to form the CALCIUM BORO-GLUCONATE (see p. 125).

Borax, in the form of GLYCERINUM BORACIS or MEL BORACIS, is employed as a mouth-wash in aphthous conditions of the mouth and fauces. For this purpose it may be combined with potassium chlorate and tincture of myrrh. Similar preparations are also useful in the treatment of pharyngitis in the dog. Solutions

of borax are used as intramammary injections in the treatment of mastitis, but are of very doubtful value; they are also employed as douches in leucorrhœa.

Internally, boric acid checks fermentation in the alimentary canal, is excreted by the kidneys, and to a less extent in the milk and saliva, and exerts antiseptic effects on the bladder and urogenital mucous membrane.

In the treatment of vesical catarrh, boric acid in combination with other remedies is sometimes prescribed. It is occasionally employed in the treatment of fermentative diarrhœa in foals and calves.

Trinitrophenol (Trinitrophen.).—Picric Acid; Carbazotic Acid; $C_6H_2(NO_2)_3OH$.

Source.—By action of nitric and sulphuric acids on phenol.

Characters.—A bright-yellow crystalline powder; inodorous; taste very bitter. Melting-point $122^\circ C$. *Solubility*.—1 in 90 of water; 1 in 10 of alcohol; solutions yellow.

ACTIONS AND USES.—Picric acid is a powerful antiseptic; it coagulates albumin and is somewhat irritant to the skin and mucous membranes when first applied, but this action is followed by a marked analgesic effect.

In the form of a saturated aqueous solution, it is a very useful application in the treatment of burns and scalds.

A 2 per cent. solution in 70 per cent. alcohol is a skin antiseptic.

ORGANIC ACIDS.

Acidum Aceticum (Acid. Acet.).—Acetic Acid; Hydrogen Acetate, CH_3COOH , 33 per cent. by weight, in Water.

Source.—Prepared by destructive distillation from wood.

Characters.—A clear, colourless liquid, with a pungent odour and strong acid reaction. Sp. gr. 1.044. Acetates evolve odour of acetic acid on addition of H_2SO_4 . *Incompatible* with alkalis, carbonates, salicylates, benzoates. *Impurities*.—Lead, copper, arsenium; chlorides, nitrates, sulphates, sulphites, formates and empyreumatic matter.

Acidum Aceticum Dilutum (Acid. Acet. Dil.).—Diluted Acetic Acid; Acetic Acid 15.26 g. in Distilled Water to 100 ml. Contains 6 per cent. of Hydrogen Acetate. Sp. gr. 1.008.

Oxymel (Oxymel).—Acetic Acid, 30; Water, 30; Purified Honey, 140.

Acetum—Vinegar (*not official*).

PREPARED by the acetous fermentation of a mixture of malt and unmalted grain (contains 5.41 per cent. of acetic acid).

ACTIONS AND USES.—*Externally*, strong acetic acid is corrosive and irritant; the dilute acid, when applied in sufficient amount

is a stimulant and vesicant. The strong acid is frequently employed as a caustic for warts. Vinegar, when quickly applied to scalded surfaces, prevents blistering and rapidly relieves the pain.

Internally, the strong acid is a corrosive irritant poison, the dog being more susceptible to its actions than horses or cattle; 4 or 5 ounces of vinegar are stated to have produced fatal effects in the dog.

ANTIDOTES.—Magnesia, lime-water, chalk and water.

The dilute acid and vinegar are antidotes in poisoning by alkalis. They are also employed in pharmacy as solvents for certain drugs, such preparations being termed 'aceta'—e.g., Acetum Scillæ.

Acidum Tartaricum (Acid. Tart.).—Tartaric Acid; Dextrorotatory Hydrogen Tartrate, $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ or $(\text{CH}.\text{OH}.\text{COOH})_2$.

Source.—Prepared from acid potassium tartrate.

Characters.—Colourless monoclinic prisms, with a strongly acid taste. *Solubility*.—Readily soluble in less than 1 of water, and 1 in 3 of alcohol 90 per cent. An excess gives with acetates a white crystalline precipitate. Soluble tartrates give a white precipitate with excess of lime-water. 10 parts neutralize 13.25 parts of potassii bicarbonas, 11.25 of sodii bicarbonas, and 7 parts of ammonii carbonas. *Incompatible* with alkalis, carbonates, vegetable astringents, and salts of potassium, calcium, lead and mercury. *Impurities*.—Copper, arsenium, iron, calcium, lead, oxalates.

Acidum Citricum (Acid. Cit.).—Citric Acid; Hydrogen Citrate; $\text{C}_3\text{H}_4\text{O}_7$ or $(\text{COOH})_3.\text{H}_2\text{O}$.

Source.—Obtained from the juice of the fruit of various species of citrus.

Characters.—Large colourless prisms, with an acid taste. *Solubility*.—2 in 1 of water; 2 in 3 of alcohol 90 per cent.; slightly soluble in ether. Soluble citrates give a white precipitate when boiled with lime-water (no precipitate with acetates). 35 gr. in 1 fl. oz. of water, or 8 per cent., make a solution resembling lemon-juice in strength and acidity; 10 parts neutralize 14.25 parts of potassii bicarbonas, 12 of sodii bicarbonas, and 7.5 of ammonii carbonas. *Incompatible* with alkalis, carbonates, bicarbonates, salicylates, benzoates, and potassium tartrate. *Impurities*.—Lead, copper, iron, calcium, sulphates; tartaric acid, detected by precipitation with potassium acetate.

ACTIONS AND USES.—Citric and tartaric acids are devoid of irritant or toxic properties. Tartaric acid is seldom employed in veterinary practice.

Externally, in the treatment of infected wounds Almroth Wright recommended irrigation with a 5 per cent. solution of sodium chloride mixed with $\frac{1}{2}$ per cent. of citrate of soda, the object being to increase the outflow of lymph from the wound, and thus to wash the infecting bacteria out of the walls of the wound (lymph lavage) and also to assist phagocytosis. The solution of common salt brings into play osmotic forces, and 'draws' the lymph

out of the walls of the wound by *vis a fronte*. The citrate of soda is added with a view to decalcify and render incoagulable the outflowing lymph (see p. 116).

The method of 'lymph lavage' was extensively adopted in the treatment of projectile wounds in horses under conditions of war, and it has proved one of the most valuable methods of wound treatment in veterinary surgery.

Internally, citric acid is not prescribed as such, but citrate of potassium is sometimes employed as a diuretic, and for the purpose of rendering the blood and urine more alkaline. If injected intravenously, potassium citrate, in common with other citrates, retards the clotting power of the blood, this action depending on the formation of calcium citrate.

Sodii Citras (Sod. Cit.).—Sodium Citrate.

Source.—May be obtained by the interaction of sodium carbonate and citric acid.

Characters.—White granular crystals or crystalline powder; odourless; taste saline; soluble 1 part in less than 2 parts of water.

As indicated above, sodium citrate is employed in the lavage of wounds with hypertonic saline solution to prevent coagulation of lymph. It may also be employed to prevent the clotting of whole blood intended for intravenous or subcutaneous injection or for chemical analysis. Citrated blood may conveniently be prepared by adding 1 c.c. of a 10 per cent. solution to every 100 c.c. of blood that is withdrawn, shaking continuously the container vessel during the process of mixing.

Glycerophosphates. — Acidum Glycerophosphoricum (B.P.C.), $C_3H_5(OH)_2OPO(OH)_2$, is a clear colourless liquid with acid taste.

Calcii glycerophosphas (B.P.C.), $Ca_3C_3H_5(OH)_2PO_4$, occurs as crystalline leaflets or a powder, soluble in water.

Glycero-phosphates are frequently prescribed in canine practice as nervine tonics (see p. 79).

GROUP VI—WATER AND OXYGEN.

AQUA.

ACTIONS AND USES.—*Externally*, water is employed as a means of applying either cold or heat to the surface of the body.

Cold water is refrigerant, and exerts tonic and constricting effects on the parts to which it is applied. It causes contraction of the bloodvessels, and lessens the supply of blood to the part. In the horse it is extensively employed to reduce inflammatory action in traumatic arthritis, inflammation of the sheaths of tendons, strains of tendons and ligaments, etc. In such condi-

tions the parts may be irrigated by means of a continuous flow of water from a hose-pipe.

Cold water dashed over the head and neck acts reflexly as a cardiac and respiratory stimulant. It is sometimes employed in narcotic poisoning, but is of little use in overcoming the toxic effects of chloroform.

Ice, as a local application to the head, is employed in meningitis and in encephalitis.

Hot water applied in the form of fomentation is emollient and anodyne. It dilates capillaries, relaxes the tissues, and thus relieves pain.

As a rule, when pain and tension are in evidence, the use of hot applications is indicated; these must, however, be used with discretion, whether in the form of fomentations or poultices. They must not be employed too hot, and the suitable temperature should be ascertained by testing them with the point of the elbow, and not with the hand, as the skin of the hand is not sufficiently sensitive for the purpose. In certain conditions hot applications are contra-indicated, as they increase the tendency to sloughing of the skin and subcutaneous tissues.

In equine practice the use of hot fomentations to the thoracic walls in respiratory affections, and to the abdominal region in colic, would be more serviceable if it were possible to apply them satisfactorily. The large area to be treated, and the difficulty of keeping the hot applications (which are usually blankets wrung out of hot water) in close contact with the skin, render it very difficult to maintain a continuous application of heat and so prevent chill.

In canine practice, however, the application of heat by means of flannel wrung out of hot water can be carried out with much greater facility.

The inhalation of water vapour, medicated with oil of eucalyptus or terebene, proves very useful in the treatment of nasal catarrh, laryngitis, and bronchitis in all animals.

Water at a temperature of 120° F. is a hæmostatic, and may be employed for this purpose when other means are not available. Warm water is also employed in the form of enemata (see p. 98) and of baths (see p. 96).

Internally, cold water should be freely allowed in the treatment of febrile affections; it allays thirst, promotes the action of the bowels and kidneys, and lowers temperature.

Cold water is contra-indicated directly after feeding, or for a horse which is in a heated condition after exertion; also after the administration of a cathartic dose of aloes, when only tepid drinks should be allowed.

'Ice-water' is employed as a gastric sedative in acute gastritis in the dog.

Warm water is emetic, and agents given for the purpose of producing reflex emesis are frequently administered in this medium.

Aqua Destillata (Aq. Dest.).— H_2O ; Pure Water prepared by distillation from good natural potable Water.

Distilled water is used in preparing medicines of every kind.

OXYGEN.

Oxygenium (Oxygen.).—Oxygen; O .

Source.—By the fractional liquefaction of liquid air. It is supplied in cylinders containing 20 or 40 cubic feet.

In pneumonia in man, the inhalation of oxygen is frequently employed, but the practical value of this treatment has not been demonstrated in veterinary practice.

The intramammary injection of oxygen by means of a special apparatus was used in the treatment of milk fever, since some authorities believed that the curative effect which follows intramammary insufflation with atmospheric air was due to the introduction of oxygen into the gland. It is now known that gaseous distension of the udder acts by mechanically increasing intramammary pressure, and so indirectly increasing the blood calcium content (see p. 463).

Liquor Hydrogenii Peroxidi (Liq. Hydrog. Perox.).—Solution of Hydrogen Peroxide; H_2O_2 .

Source.—Made by the interaction of water, barium peroxide and a dilute mineral acid below $10^\circ C$.

Characters.—A colourless, odourless liquid, with a slightly acid taste; it renders the saliva frothy. Decomposed by heat into $H_2O + O$. **Impurities, etc.**—Barium, mineral matters. One volume should yield 9 to 11 volumes of oxygen.

ACTIONS AND USES.—Peroxide of hydrogen, by liberating free oxygen, is antiseptic. It is non-poisonous, and, although causing a smarting sensation when applied to a wound, it is scarcely irritant, and does not precipitate albumin.

The solution of hydrogen peroxide may be diluted with 3 volumes of boiled water for ordinary surgical purposes. It forms an efficient antiseptic, and is largely employed in veterinary practice. When brought into contact with pus or blood, a profuse foamy effervescence results. In the case of punctured wounds, after providing free drainage, the part may be thoroughly irrigated with the solution.

In otorrhoea in the dog, when associated with profuse sup-

puration, the solution may be instilled into the meatus; the part is then cleansed and dried with gauze.

In purulent conjunctivitis, a dilute solution of hydrogen peroxide forms a useful collyrium. The agent makes an efficient mouth-wash in canine practice, and is also useful as a uterine injection in metritis. It is important to note that the antiseptic action is transient.

Intramammary injections of hydrogen peroxide have been used in mastitis, but are of little or no value.

GROUP VII—CARBON AND ITS COMPOUNDS.

CARBO (CARBON, CHARCOAL).

Two forms of carbon are recognized—viz.: (1) Carbo Ligni; (2) Carbo Animalis.

Carbo Ligni.—Wood Charcoal (*not official*).

Source.—The carbonaceous residue of wood charred by exposure to a red heat without access of air.

Characters.—A black powder, without taste or odour, free from gritty matter. Ash not more than 7.5 per cent.

CARBO ANIMALIS—Animal Charcoal (*not official*).

PREPARED by exposing bones to a red heat, without access of air, and powdering the residue.

GENERAL ACTIONS.—*Externally*, charcoal possesses the property of adsorbing gases and vapours and is thus a deodorant.

Internally, charcoal given in sufficient amount adsorbs gases formed in the stomach and small intestine. It is also capable of adsorbing alkaloids and bitter principles.

Charcoal is wholly excreted by the intestines, being incapable of absorption by the intestinal mucosa.

MEDICINAL USES.—*Externally*, it is occasionally employed as a deodorant to unhealthy ulcers or foul wounds, being applied directly in the dry form; but it does not possess antiseptic actions, and other agents are to be preferred.

Internally, charcoal is sometimes prescribed in dyspepsia accompanied by flatulence, in doses of ʒss. to ʒii. for horses and cattle, and grs. xx. to ʒi. for dogs, but its value is doubtful. It may be given in cases of poisoning in the dog by alkaloids, but after administration the stomach should be quickly emptied.

Carbonei Disulphidum.—Carbon Disulphide; CS₂ (*not official*).

Source.—From carbon and sulphur combined at a high temperature, followed by condensation and purification.

Characters.—A clear, colourless, highly refractive liquid; odour characteristic. Sp. gr. 1.268. *Soluble* in alcohol, ether, chloroform, and fixed and volatile oils; very slightly in water. Highly inflammable; boiling-point $46^{\circ}\text{C}.$; rapidly evaporating at ordinary temperatures. *Impurity.*—Sulphur.

Carbon disulphide has been used in equine practice to destroy the larvæ of *Æstrus equi* and in ascaridiasis. The doses advised are: horses, ʒii. to ʒiv. ; foals, ʒi. to ʒii. ; administered in gelatin capsules, and repeated in two hours. No purgative is administered.

Carbonei Tetrachloridum (Carbon. Tetrachlor.).—Carbon Tetrachloride (CCl_4).

Source.—May be prepared by the action of chlorine on carbon disulphide.

Characters.—Carbon tetrachloride is a heavy, colourless liquid with an odour like that of chloroform.

Doses.—Horses, ʒvii. to ʒxiv. ; sheep, ʒxvii. ; dogs, ʒii.ss. per pound body weight. Average dose, ʒi. Pigs, ʒi. for each hundred pounds body weight. Administered in capsule to the fasting animal.

The dosage of carbon tetrachloride for the horse, pig, and dog has not yet been satisfactorily determined.

ACTIONS AND USES.—Minot has shown experimentally that the dog can withstand very large doses provided there be a sufficiency of ionized calcium in the blood. On the other hand, if a condition of acute hypocalcæmia exist, relatively small doses of carbon tetrachloride may prove fatal.

The toxic symptoms observed in dogs are loss of appetite and a noticeable lack of energy during the first twenty-four hours. The animal may then become somnolent or actually comatose. In many cases there develops a condition of general tetany involving the diaphragm with consequent spasmodic breathing. In either type death occurs forty to sixty hours after administration. During the course of the illness there is a marked rise in the bilirubin content of the blood, and on autopsy the liver shows extensive damage.

Antidotal treatment consists in the intravenous or subcutaneous injection of calcium borogluconate.

Carbon tetrachloride has been found of great value in the treatment of liver rot in sheep. No preparation of the sheep previous to treatment is necessary. The drug is administered in soft gelatin capsule, and the treatment may with advantage be repeated after a period of one month, since the drug appears to act only on mature flukes, and further dosing is necessary to destroy immature flukes as these reach maturity.

No purgatives are given before or after treatment. Care should be taken that the capsule be properly administered, since,

should the capsule break in the mouth, the drug will be inhaled and alarming symptoms of general anæsthesia may appear. In such event a free supply of oxygen must be allowed, when the symptoms usually pass off quickly without recourse being had to artificial respiration.

Carbon tetrachloride is said to be practically non-irritant to the alimentary canal.

It is an efficient anthelmintic against round-worms.

Carbonei Dioxidum (Carbon. Diox.).—Carbon Dioxide (CO_2).

Source.—May be obtained from mineral carbonates or from the fermentation of sugar.

Is procured compressed in metal cylinders.

Characters.—A heavy colourless gas; taste of an aqueous solution faintly acid.

Carbon dioxide is employed as a means of stimulating the respiratory centre in conditions such as arise from failure of the centre under general anæsthesia or from the effects of narcotics. It is also employed to improve ventilation of the lungs in conditions such as pneumonia. A mixture of oxygen and carbon dioxide appears to give the best results, and the administration must be combined with artificial respiration should breathing have ceased (p. 179).

ALCOHOL.

Alcohol Dehydratum (Alcoh. Dehyd.).—Absolute Alcohol. Ethyl Hydroxide, $\text{C}_2\text{H}_5\text{OH}$, with not more than 1 per cent. by weight of Water. Contains 99.4 to 99.95 per cent. Ethyl Hydroxide.

Source.—Obtained by the removal of water from less strong ethylic alcohol, and subsequent distillation.

Characters.—Colourless, very volatile and hygroscopic at common temperatures. Sp. gr. 0.7940 to 0.7969. *Impurities.*—Excess of water; giving blue colour with anhydrous copper sulphate; those of alcohol.

Alcohol (Alcoh.).—Alcohol 95 per cent. A liquid containing 95 parts by volume of Ethyl Hydroxide, $\text{C}_2\text{H}_5\text{OH}$, and 5 parts by volume of Water.

Source.—Obtained by distillation of fermented saccharine liquids. $\text{C}_6\text{H}_{12}\text{O}_6$ (grape sugar) $= 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$.

Characters.—Colourless, transparent, very mobile, and inflammable; odour characteristic, pleasant; taste strong, spirituous, burning. Burns with a smokeless blue flame. *Impurities.*—Water, tested volumetrically; fusel oil and its allies, leaves no unpleasant odour when evaporated in cold; amylic alcohol, beyond a trace, and organic matters, detected by excessive reduction of AgNO_3 ; aldehyde, tannin, detected by darkening with NaOH or NH_4OH ; resins or oils, giving turbidity on dilution with water; and fixed matters.

Diluted Alcohols—

Are obtained by diluting alcohol (95 per cent.) with distilled water. The eight official preparations contain, respectively, 90, 80, 70, 60, 50, 45, 25, and 20 per cent. of ethyl hydroxide by volume, and are

employed for pharmaceutical purposes. Alcohol (90 per cent.) is also known as *SPIRITUS RECTIFICATUS*; Rectified Spirit (*not official*).

The diluted alcohols are used in preparing chloroform, many tinctures, spirits, liniments, and other preparations.

Spiritus Methylatus Industrialis (Sp. Meth. Indust.).—Industrial Methylated Spirit is a mixture of 19 volumes of Alcohol (95 per cent.) with 1 volume of Wood Naphtha.

Characters.—Similar to those of alcohol (95 per cent.), but having in addition the odour of wood naphtha.

SPIRITUS METHYLATUS—Methylated Spirit (*not official*).

A mixture of alcohol (95 per cent.) with 10 per cent. by volume of wood naphtha. For retail use it contains in addition, $\frac{3}{8}$ per cent. of mineral naphtha, when it is known as 'denaturalized methylated spirit,' and forms a turbid mixture with water. It is not employed for internal use.

Vinum Xericum.—Sherry (*not official*). A Spanish Wine.

Characters and Composition.—Pale yellowish-brown. Contains not less than 16 per cent. by volume of *ethyl hydroxide*, and in 100 ml. from 0.1 to 0.2 g. of volatile acids calculated as acetic acid, and from 0.3 to 0.45 g. of fixed acids calculated as tartaric acid. *Impurity*.—Salicylic acid.

Spiritus Vini Gallici.—Brandy (*not official*). A spirituous liquid distilled from wine and matured by age.

Characters and Composition.—A spirit of a light sherry colour, and peculiar flavour. Contains not less than 36.5 per cent. by weight, or 43.5 per cent. by volume, of *ethyl hydroxide*, with some *ethylic ether* combined with *acetic* and other *ethers*, and traces of *volatile oils*.

Amount of alcohol by volume in various important substances containing it. (Figures in brackets indicate strength in 1921.)

* Alcohol absolutum, 99 per cent.

Spiritus rectificatus, 90 per cent.

Spiritus vini gallici (brandy), 43.5 per cent. (40 per cent.).

Spiritus frumenti (whisky), 44 to 45 per cent. (32 to 40 per cent.).

Rum } 51 to 59 per cent. (33 to 40 per cent.).
Gin }

Strong liqueurs, about 51 to 59 per cent.

Port, sherry, and madeira, about 16 to 22 per cent.

Champagne, about 10 to 13 per cent.

Vinum aurantii, 15 to 17 per cent.

Hock and burgundy, about 9 to 15 per cent.

Claret, 8 to 12 per cent.

Ale and porter, about 3, 5 (or more) per cent.

Cider, 5 to 9 per cent.

(Bruce and Dilling.)

ACTIONS.—*Externally*, when applied to the skin, alcohol exerts a cooling effect because of its rapid volatilization. It also hardens the cuticle, because of its power of absorbing water and precipitating proteins.

If evaporation be prevented, or if the agent be applied with friction, a local vaso-dilatation is produced, hence it is rubefacient.

Alcohol also exerts an antiseptic action when applied to the skin.

The Mouth.—Internally, alcohol acts as a reflex sialagogue by directly stimulating the buccal mucosa.

The Stomach.—The secretion of gastric juice is increased chiefly by the local stimulation of the gastric mucosa. The drug does not cause the secretion of active ferment, but the secretion of acid is augmented. In moderate doses it is very rapidly absorbed from the stomach.

The Intestine.—Alcohol resembles the volatile oils in that it overcomes intestinal spasm and thus is carminative. The digestion of proteins is slightly accelerated, and the pancreatic secretion is somewhat increased. Port and brandy are intestinal astringents.

Central Nervous System.—The psychical phenomena that occur in man as the result of his taking alcohol are not observed in animals after its administration. The precise action of alcohol on the central nervous system has not been determined. According to some authorities the nerve cells are first stimulated and later are depressed, while others believe that the drug exerts a depressing effect on the central nervous system from the commencement. The higher centres are first depressed, and as the result of toxic doses paralysis of the medulla finally occurs. The primary stimulating effects observed in man after moderate doses are said to arise from depression of the higher emotional centres, thus leading to the abolition of the normal faculties of self-restraint—shyness.

The effects of alcohol on man exemplify the *law of dissolution*. Large doses at first stimulate, then depress, and finally paralyze the nerve-centres in the inverse order of their development.

The higher mental (emotional) centres are first affected, and the actions continue in orderly procession until the lowest reflex centres are involved. Finally, death occurs from paralysis of the vital centres.

Circulatory System.—Small doses cause a slight acceleration of the *pulse*, due to reflex stimulation from the stomach.

The superficial *bloodvessels* are considerably dilated, while the systemic vessels are constricted. The latter action is partly due to stimulation of the medulla, but also depends on peripheral stimulation. Large doses cause dilatation of all the vessels throughout the body.

The *blood-pressure* is generally raised, this effect being due to the vaso-constriction that is present, and also to the cardiac stimulation.

Temperature.—Moderate doses cause a lowering of the tem-

perature, this effect depending chiefly on the dilatation of the cutaneous vessels, permitting increased loss of heat.

Respiration.—Some authorities believe that alcohol exerts a direct stimulating action on the respiratory centre, which action, although slight, is decided. Others consider that the stimulant action on respiration is due to a reflex effect from the stomach. According to Dixon, the most probable explanation of the stimulant action of alcohol on respiration is that the drug causes an increased loss of heat from the surface of the body, and in consequence heat production is augmented to make good the loss; hence there is a compensatory increase in the oxygen intake, and increased combustion. The agent is therefore an indirect stimulant to respiration.

Metabolism.—Experiments show that alcohol in moderate doses is almost entirely oxidized in the body, and yields energy. It spares the oxidation of fat and increases the metabolism of protein. If continued for a long period, so that the tissues become tolerant of its toxic action, the drug acts as a protein sparer, and the body is increased in weight. Experiments have also shown that, in moderate doses continued for some time, alcohol acts as a food, so long as the amount of the drug in the body can be oxidized and destroyed by the tissues. When an excessive amount is present in the body, it exerts a toxic action on the tissues. If the drug be present to the extent of 0.5 per cent. in the blood, profound intoxication results. Only 1 or 2 per cent. of alcohol is excreted in the urine. The process of oxidation is slow, as it has been shown that after the administration of a small dose the amount circulating in the blood remains constant for about two hours.

Toxic Actions.—In excessive doses alcohol acts as a narcotic poison, and proves fatal by producing paralysis of the vital nerve-centres.

After a stage of excitement the functions of the brain become disturbed, then loss of consciousness occurs, and, if very large amounts have been given, a condition of paralysis of the vital nerve-centres ensues. The more concentrated forms of alcohol prove much more toxic than diluted solutions (by reflex action). Usually the respiratory centre is the first to become paralyzed, but in some instances respiration and circulation fail simultaneously.

In the horse preliminary excitement is well marked and accompanied by an unsteady gait, with spasmodic movements of the limbs; the pupils are at first contracted, then dilated, and in the final stages convulsions and/or coma occur.

In the dog there is very little preliminary excitement, and

after a toxic dose has been administered the animal becomes rapidly comatose.

Cattle and sheep are less susceptible to the action of alcohol, and are only affected by large amounts.

Cases are recorded of chronic alcoholic poisoning in cattle supplied with the dregs or wash from distilleries; but with this exception poisoning by alcohol is very rare in veterinary practice. The suitable *antidotes* consist in the application of cold water to the head and neck and the hypodermic injection of strychnine or caffeine.

MEDICINAL USES.—*Externally*, because of its rubefacient action, alcohol enters into the composition of various liniments. As a skin antiseptic it is most effective in a dilution of 70 per cent., but for this purpose it is usually used as a solvent for iodine or picric acid.

Internally, in former times whisky was largely employed as a stimulant in influenza and pneumonia in horses. Clinical observation, however, has shown that, when stimulants are indicated, better results are achieved by the administration of agents such as strychnine and caffeine. Indeed, the administration of draughts of alcohol is neither necessary nor desirable, and this practice has now been largely discontinued.

In cases in which a general stimulant is indicated, a full dose of whisky may be prescribed, as, for example, when, in the early stages of influenza, rigors are present, or at the commencement of an attack of acute pulmonary congestion. In such instances from 6 to 10 ounces of whisky, suitably diluted, often proves beneficial, but it is rarely desirable to repeat the dose. In cases of severe diarrhoea in foals, port wine, combined with other suitable agents, is useful. Some horses will voluntarily take whisky in the drinking water, and in such instances, when diffusible stimulants are indicated, alcohol can be administered in this manner.

In cattle practice, alcoholic stimulants are useful adjuncts to other treatment in atony of the stomach, and for this purpose strong ale, in doses of from 1 to 2 pints, three times daily, proves beneficial.

In canine practice alcoholic stimulants are often prescribed, but they should be used with discretion.

CONTRA-INDICATIONS.—Alcohol is contra-indicated in all conditions of cerebral excitement, congestion of the brain, meningitis, etc.; in shock depending on concussion or injury to the brain; and in nephritis, hepatitis, and gastritis.

THE ACTION OF GENERAL ANÆSTHETICS.

General anæsthetics produce loss of consciousness, and abolish sensation and voluntary muscular action. The vapour of certain volatile drugs, when inhaled, has the power of producing these effects, and in veterinary practice the agents employed as general anæsthetics are chloroform and ether. Hypnotics, if administered in large doses, bring about complete anæsthesia; but they are slowly absorbed and slowly excreted; a certain amount remains in the blood for some hours, and the depressant action is therefore prolonged. On the other hand, chloroform and ether are rapidly absorbed and excreted, and the effects last only so long as the administration is continued.

The intravenous administration of a soluble barbiturate provides a convenient method of inducing anæsthesia in small animals such as the dog and cat. This method has also proved effective when applied to the sheep and pig.

The precise manner in which certain narcotics and anæsthetics produce their effects is unknown. The activity of a living cell is dependent upon the maintenance of a selective permeability in its cell membrane, and in consideration of all the available evidence A. J. Clark suggests that 'the simplest explanation of the mode of action of anæsthetics is to suppose that they produce a similar action on all cells, the action being probably an interference with the selective permeability of the surface membrane of the cells. The apparent specific action may be explained by supposing that the brain cells are very readily paralyzed by any disturbance of their surface membrane, while other cells are far more resistant.'

CHLOROFORMUM.

Chloroformum (Chlorof.).—Chloroform; Chloroform is Trichloromethane CHCl_3 , to which 2 per cent. of Absolute Alcohol has been added. It should be kept cool in a dark place.

Source.—Made by distilling alcohol, industrial methylated spirit, or acetone with chlorinated lime and slaked lime (oxidizing and chlorinating the alcohol); thereafter purifying by washing with water and sulphuric acid, agitating with slaked lime and calcium chloride, and redistilling; and lastly adding absolute alcohol. The sulphuric acid chars and removes hydrocarbons, without affecting the chloroform; the lime frees it from acid, the calcium chloride from moisture.

Characters.—A colourless liquid, of characteristic odour and pungent sweet taste. **Solubility.**—Freely in alcohol, ether, olive oil and turpentine; 1 in 200 of water, in which it sinks in heavy drops. Sp. gr. 1.483 to 1.487. Does not boil below 60°C . **Impurities.**—Acids, free chlorine, chlorides, fixed matter. When exposed to light and air with no alcohol added, chloroform decomposes into carbonyl

chloride and chlorine, which are irritant when inhaled. The former is detected by adding baryta water, when a white ring forms at its junction with the chloroform. Alcohol prevents this decomposition.

Doses.—Administered by the *mouth* as an antispasmodic and analgesic: Horses, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; sheep and pigs, $\mathfrak{M}\text{xx.}$ to $\mathfrak{M}\text{xl.}$; dogs, $\mathfrak{M}\text{v.}$ to $\mathfrak{M}\text{x.}$ Given with syrup, mucilage, or in diluted spirit.

Aqua Chloroformi (Aq. Chlorof.).—Chloroform, 0.25; Water to 100.

This is used for preserving medicinal solutions, and also as a flavouring agent for unpalatable drugs in canine practice.

Spiritus Chloroformi (Sp. Chlorof.).—Spirit of Chloroform; Chloric Ether; Chloroform, 5; Alcohol, 90 per cent. to 100.

Doses.—Horses, $\mathfrak{z}\text{i.}$; cattle, $\mathfrak{z}\text{ii.}$; sheep and pigs, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; dogs, $\mathfrak{M}\text{xxx.}$ to $\mathfrak{M}\text{xl.}$

Linimentum Chloroformi (*not official*).—Chloroform, 1, to 1 of Liniment of Camphor (see p. 282).

A.C.E. Mixture (*not official*)—

Contains absolute alcohol, 1 part; chloroform, 2 parts; and purified ether, 3 parts.

Tinctura Chloroformi et Morphinae Composita (*not official*).—Made by dissolving Morphine Hydrochloride, 1, in a mixture of Oil of Peppermint, 0.2; Chloroform, 7.5; Tincture of Capsicum, 2.5; Tincture of Indian Hemp, 10; Glycerin, 25; and Alcohol 90 per cent., 45; adding Diluted Hydrocyanic Acid, 5; and Alcohol to 100. 10 min. contain $\frac{3}{4}$ min. of Chloroform, $\frac{1}{11}$ gr. of Morphine Hydrochloride, and $\frac{1}{2}$ min. of Diluted Hydrocyanic Acid. See Chlorodyne (p. 231).

Doses.—Horses and cattle, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; dogs, $\mathfrak{M}\text{v.}$ to $\mathfrak{M}\text{xv.}$

GENERAL ACTIONS OF CHLOROFORM.

The actions of chloroform in many respects resemble those of alcohol, but are more powerful.

Externally, chloroform acts as a refrigerant, and also depresses the termination of sensory nerves. If the vapour be confined, or if the drug be applied to the skin with friction, it is irritant, and may actually produce vesication. It is antiseptic and antiparasitic.

Internally, if administered in small doses by the mouth, it is carminative, antispasmodic, and anodyne. Unless properly diluted with mucilage or oil, it causes severe irritation of the buccal mucosa.

When administered by *inhalation*, chloroform is a general anæsthetic, and the actions of chloroform, like those of alcohol, follow the law of dissolution (see p. 184).

Three stages of chloroform anæsthesia can be observed in

veterinary practice; they cannot, however, be precisely differentiated, but merge insensibly into one another. Marked variations occur in their duration and intensity.

The *first* or *stimulant* stage is characterized by excitement, struggling, and accelerated respirations. The excitement is believed to be due to the fact that consciousness has become dulled and the subconscious emotions have assumed control.

Because the normal inhibitory influence of the higher centres is removed the reflex responses are generally exaggerated. Certain reflex effects occur as the result of the local irritating action of the vapour of the drug on the respiratory passages, such as salivation, hypersecretion from the bronchial mucosa, and occasionally coughing. Two reflex effects also occur from the action of the chloroform vapour on the nasal mucosa. One is a temporary 'holding of the breath,' which depends on irritation of the nerve-endings of the fifth cranial nerves. This is frequently observed in the horse, and lasts only for a short time. The other is a slowing of the heart's action, and it depends on a similar cause. Dilatation of the pupils (probably due to increased secretion of adrenaline) and frequent lateral movements of the jaws may also be present.

The duration of the stimulant stage is very variable, and the period of excitement depends to a great extent upon the temperament of the animal and the mode of administration of the drug.

Towards the end of the primary stage there occur marked depression of the higher centres and numbing of the sensibilities.

In the *second* or *anæsthetic* stage, consciousness and sensibility are removed, voluntary muscular action is lost, the muscles are relaxed, and the reflexes are markedly lowered, although the corneal reflex may still be elicited; the respirations are regular and somewhat slower than normal, and the pupils are slightly contracted. It is at this period that surgical operations are performed, there being absence of movement, insensibility to pain, and the heart reflexes being so depressed that the danger of surgical shock is minimized.

If the administration of the drug be pushed still further, a *toxic* or *paralytic* stage is reached, the vital nerve-centres in the medulla become paralyzed, and there is complete loss of all reflex excitability; even the lowest reflex centres of the cord may be paralyzed, with consequent involuntary passage of urine and fæces. The respiratory centre is usually the first to fail; the respirations become shallow, irregular, and finally cease; the pupils are widely dilated, and the pulse is rapid and feeble. It is of importance to note that in the horse death is often preceded by convulsive movements of the fore and hind limbs.

As the safe administration of chloroform depends upon a knowledge of its pharmacological actions, these will now be considered *seriatim*.

ACTION ON RESPIRATION.—In the first stage in man the respiratory movements are rendered slower owing to irritation of the nerve-endings of the fifth nerves in the nasal mucosa. In animals, because of the excitement and struggling produced by restraint, in addition to the irritating effects of the drug on the respiratory mucosa, the respirations are accelerated and irregular. During the anæsthetic period the respirations become slower than normal, and more shallow (depression of respiratory centre). If chloroform inhalation be pushed beyond the anæsthetic stage the respiratory centre fails, and this effect is generally believed to depend on the marked fall of blood-pressure which is produced by the drug. In the majority of cases death results from respiratory failure, but occasionally the patient succumbs so rapidly that the heart and respiration appear to fail simultaneously. Usually, when an excess of chloroform has been administered to the horse, the respiratory movements become quick and shallow; later a long inspiration is observed, followed by a temporary cessation of respiratory movements, then a series of quick, shallow respirations occur, and respiration finally ceases. The heart beats in a feeble and irregular manner for a short time after respiration ceases. Oral breathing, accompanied by marked stertor, may also be observed. Cases, however, are met with in which, as the result of sudden reflex depression of the respiratory centre, due to irritation of the fifth nerve-endings by too concentrated a vapour, respiration ceases without any preliminary warning; these are more common in dogs than in horses.

ACTION ON CIRCULATION.—In the horse death rarely occurs from syncope during the first stage of chloroform anæsthesia, but in the dog it is not uncommon. Experiments indicate that the fatal termination results from the rapid absorption of concentrated chloroform vapour, especially when an animal is breathing irregularly, and thus inhales a large quantity of the vapour of the drug at one inspiration. Death results from sudden inhibition of the heart, due to reflex stimulation of the vagal centre in the medulla.

As the result of irritation of the respiratory tract, the vasomotor centre in the medulla is reflexly stimulated during the early stages of chloroform inhalation, but this action is transient, and is soon followed by depression of the centre.

Chloroform exerts an important action on the heart. The cardiac muscle, in common with all forms of muscular tissue,

is directly depressed, its force of contraction is diminished, and blood-pressure falls. As the result of excessive dosage the contractile power of the heart muscle becomes still more diminished, cardiac dilatation results, and the heart becomes over-distended with blood.

Thus during the stage of excitement chloroform stimulates the vasomotor centre, and so causes constriction of internal vessels, dilatation of the cutaneous vessels, and a raising of blood-pressure. These effects are transient, as the centre soon becomes depressed, and ultimately paralyzed; the blood-pressure falls because of the vaso-dilatation and of the diminished output from the heart.

Chloroform has only a slight effect on the movements of the bladder, intestines, or uterus, and if administered during parturition the uterine contractions are influenced only to a relatively slight extent. During chloroform anæsthesia the temperature of the animal steadily falls.

USES.—Chloroform given in medicinal doses *per os* is sometimes employed as a carminative, antispasmodic, and anodyne, and is prescribed in the form of spirit of chloroform. It has recently been employed in the treatment of verminous bronchitis in sheep. Administered by inhalation until the animal staggers, it is said to give excellent results.

Chloroform is principally employed as a general anæsthetic.

CHLOROFORM ANÆSTHESIA.

In a work of this kind the technical details of chloroform administration cannot be considered, but the methods commonly adopted will be discussed generally.

HORSES.—I. By means of a muzzle inhalation apparatus arranged so that very little air is admitted, and the vapour of the drug is inhaled in a concentrated form. This method has the advantage of shortening the stage of excitement and inducing anæsthesia very rapidly. The induction of anæsthesia may be facilitated by the previous administration of a narcotic; for this purpose chloral hydrate in doses up to 1 ounce given in $\frac{1}{2}$ gallon of water by the stomach tube is the most effective. The employment of a narcotic reduces the amount of chloroform required to induce anæsthesia. A quantity of from 2 drachms to $\frac{1}{2}$ ounce suffices for the initial dose; subsequent doses of 2 drachms at intervals of a few minutes will maintain a satisfactory degree of surgical anæsthesia. If no preliminary narcotic has been given, then 1 to 2 ounces of chloroform are poured on the sponge contained

in the inhaler, and this amount usually suffices to bring about the desired degree of anæsthesia. This method is largely practised, and the remarkably few fatalities recorded indicate that the horse can inhale concentrated chloroform vapour with comparative impunity; but if during a prolonged operation it becomes necessary repeatedly to administer further amounts of the drug in order to maintain anæsthesia, then it is proper that the vapour be administered in a less concentrated form. During the first stage there is an element of risk in administering concentrated chloroform vapour, for the reasons mentioned on page 190. Special care is required in the administration of chloroform by this method to aged horses and to those in plethoric condition.

2. Many practitioners administer chloroform to the horse in the standing position. By this method there is no obstruction to respiration, such as occurs when the animal is cast and secured. The stage of excitement is shortened, and the animal assumes the recumbent position in a short time. Various forms of inhalers are used for this method, but all of them are designed so that the supply of air is limited. In order to control the horse during the stage of excitement it is desirable to have two reliable assistants. Some practitioners fix the inhaler, containing the requisite amount of the drug, to the animal's head while in the stall, before bringing him out into the open field or operating yard, where he is walked in a circle for five or ten minutes, when the appearance of swaying and staggering movements indicates the approach of anæsthesia. After the horse lies down, the stage of anæsthesia is usually soon established, when the hobbles can be quietly applied or other means for the restraint of limb movements adopted.

The condition of the corneal reflex in the horse is of uncertain value as an indication of the proper degree of anæsthesia. In many instances it persists even when a condition of deep anæsthesia is reached. Relaxation of the limbs, limp tail, and the absence of struggling when the horse is sharply struck on the quarters, are more reliable guides. Slight involuntary or purposeless movements of the limbs are often observed when sensitive structures are manipulated or severed, but they are not necessarily an indication for further administration of chloroform. These movements are feeble and of short duration, and are easily distinguished from the struggling which is indicative of pain.

The state of the respirations is the most reliable guide in indicating the condition of the animal during anæsthesia. Should the respirations become laboured, shallow, or irregular, the

apparatus should be immediately removed, the animal's tongue drawn forward, and artificial respiration applied.

Pallidity of the conjunctiva and a rapid, weak, and irregular pulse are evidences of cardiac depression, and in such cases the administration of the drug must be at once stopped and heart and respiratory stimulant treatment applied. Cardiac stimulants may take the form of intravenous injections of caffeine, atropine, camphor, or adrenaline, or transfusions of normal saline solution; alcohol should not be used as a stimulant, as its actions resemble those of chloroform.

In those cases in which circulation and respiration appear to cease simultaneously, little can be done, as death takes place suddenly, and usually without premonitory symptoms. One such premonitory symptom consists in spasmodic contraction of the voluntary muscles, or purposeless struggling movements of the fore and hind limbs. These symptoms are commonly associated with failure of cardiac and respiratory actions, and, when they occur, the administration of the drug should be stopped immediately and antidotal treatment applied.

Not infrequently, after an operation is completed, the horse appears to pass into a condition of deeper anæsthesia, and this may continue for a prolonged period, notwithstanding the fact that the administration of chloroform has ceased. This need not cause alarm so long as the respirations are regular, but the patient should be kept under observation, so that artificial respiration may be carried out should dangerous symptoms manifest themselves.

In serious major operations the application of a local anæsthetic may, where practicable, be practised in addition to the administration of chloroform; or a narcotic such as chloral hydrate may be given previous to the administration of the general anæsthetic. Such procedure is believed to minimize the risk of surgical shock, and certainly facilitates the production of anæsthesia.

The anæsthetist must devote himself entirely to his duties, and the performance of the surgical operation should in no way engage his attention.

The patient should be prepared by withholding bulky food for about thirty-six hours previous to operation. Repletion of the stomach and intestines renders the patient more susceptible to respiratory distress, and when the stomach is comparatively empty the horse is much more readily brought under the influence of the anæsthetic. An examination of the heart should be made prior to administering chloroform.

Care should be taken that there be no impediment to free

respiration, such as might ensue from an abnormal position of the animal's head, an ill-fitting halter, or from the manipulations of the attendants while endeavouring to hold the head during a paroxysm of struggling.

While the horse is recovering from the effects of chloroform he must be prevented from injuring himself during the nervous excitement and struggling attempts to rise which are not uncommon at this stage. It is imprudent to release the animal from the hobbles until consciousness has fully returned, and he should not be forced to rise until a reasonable time has elapsed. Solid food should not be allowed until a few hours after he is returned to his stall; cases are recorded in which 'choking' has occurred as a sequel to chloroform anæsthesia.

CATTLE.—Cattle are good subjects for chloroform anæsthesia. The methods of administration are similar to those described for the horse. Because of the profuse salivation that is produced by chloroform in cattle a preliminary hypodermic injection of gr.ss. of atropine sulphate is useful.

DOG.—In the dog, great care is necessary in the administration of chloroform, and it is essential to insure a proper allowance of air. Various forms of inhalers are employed, the chief feature of which being an arrangement for the proper dilution of the chloroform vapour with air. In cases of urgency chloroform can be safely administered to the dog by means of a wide-mouthed jar or tin in which a sponge is placed; a small amount of the drug is poured on the sponge and repeated when required. Chloroform anæsthesia in dogs can be safely maintained for long periods, provided the drug be administered with a proper admixture of air. During the stage of excitement the attendant should be cautioned not to hold the animal in such a manner that interference with respiration is likely to result.

In the majority of instances when death occurs during chloroform anæsthesia in the dog, it results from respiratory failure. But occasionally the animal dies during the stage of excitement, and the action of the heart ceases simultaneously with the respirations. The measures to be adopted on the occurrence of dangerous symptoms are similar to those advised in the case of the horse. Chief reliance must be placed on artificial respiration, and this should be assiduously continued, even in cases which seem to be hopeless. The inhalation of the vapour of ammonia and the hypodermic injection of strychnine are generally advised as antidotes to the toxic effects of chloroform, but they are of very doubtful value. The intracardiac injection of 1 c.c. of a 1 in 1,000 solution of adrenaline hydrochloride in conjunction with artificial respiration has been found of considerable value.

Some practitioners advise a hypodermic injection of morphine as a useful preliminary to the administration of chloroform. This is found to diminish the period of excitement, and much less chloroform is required to produce anæsthesia.

The A.C.E. mixture is frequently employed in the dog instead of chloroform, and is safer than chloroform alone.

In difficult parturition chloroform anæsthesia proves of assistance during manipulations in effecting delivery.

In persistent abdominal pain depending on intestinal affections, in which chloral hydrate fails to give relief, chloroform may be administered by inhalation, so that a condition of light anæsthesia is induced. This can be continued for prolonged periods if necessary, and it will be found that the peristaltic action of the intestines is not interfered with as the result of the chloroform anæsthesia.

ÆTHER.

Æther (Æther).—Ether; Ethylic Ether; $(C_2H_5)_2O$.

Source.—Made by (1 and 2) distilling ethylic alcohol, added in a continuous stream, with sulphuric acid; (3) agitating with slaked lime and calcium chloride in water, and redistilling. (1) $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4$ (sulpho-vinic acid) + H_2O . (2) $C_2H_5HSO_4 + C_2H_5OH = (C_2H_5)_2O + H_2SO_4$. The process of etherification is thus continuous, sulphuric acid being re-formed and acting on a fresh quantity of alcohol. Process (3) removes alcohol, water, and oil of wine.

Characters.—A colourless, very volatile, and inflammable liquid; odour and taste strong and characteristic. Boiling point 34° to 36° C. The vapour mixed with air is explosive in contact with flame. Sp. gr. 0.720. *Solubility.*—Slightly in water. Miscible in all proportions with alcohol 90 per cent., chloroform, and fixed and volatile oils. *Impurities.*—Excess of ethylic alcohol; oil of wine; free acid.

Æther Anæstheticus (Æther Anæsth.).—Purified Ether; Ether from which most of the Ethylic Alcohol has been removed.

Source.—Made by washing with distilled water, and subsequent distillation in the presence of calcium chloride and recently-prepared lime to remove most of the water.

Characters.—Those of ether. Sp. gr. 0.720. *Impurities.*—Alcohol, water, methylic ether, ethyl and hydrogen peroxides.

Spiritus Ætheris (Sp. Ætheris).—Ether, 33; Alcohol, 90 per cent. to 100. Sp. gr. 0.802 to 0.806.

Doses.—Horses, ʒi. to ʒii. ; cattle, ʒii. to ʒiii. ; dogs, ℥xx. to ʒi. Administered, well diluted, with mucilaginous fluids, and repeated as required.

In cases of collapse, in which immediate effects are desired, the drug is administered hypodermically in one-quarter to one-half the above doses, or may be injected intramuscularly.

ACTIONS.—*Externally*, ether is a refrigerant and a local anæsthetic. It evaporates rapidly, abstracts heat, and depresses the sensory nerves of the part to which it is applied. If Purified Ether be used in the form of a spray, it freezes the skin, and thus removes sensation. If applied with friction, it produces rube-facient or even vesicant effects.

Internally, its action resembles in many respects that of alcohol, but it is absorbed and excreted more rapidly. It increases gastric secretion and gastric activity, and thus is carminative. Ether in medicinal doses has little or no direct action on the heart, but it accelerates the pulse reflexly, because of its irritant effect on the mouth and stomach. Similarly, when injected subcutaneously or intramuscularly its effects as a cardiac stimulant are reflexly induced because of its action as a local irritant.

If inhaled, ether is an anæsthetic, and in some respects resembles chloroform.

The important distinctions are as follows:

(a) Ether has a less depressing effect upon the heart and respiratory centre than chloroform.

(b) With ether the stage of excitement is prolonged, the struggling more marked, the stage of anæsthesia is shorter and less profound, and consciousness is more quickly regained.

(c) Ether must be administered in a concentrated form in order to induce anæsthesia, a concentration of about 70 per cent. of vapour being necessary in the air inhaled.

When inhaled, ether is markedly irritant; it increases secretion from the respiratory mucous membrane, and causes a flow of ropy mucus from the mouth. It produces marked acceleration of the respiratory movements, and does not cause paralysis of the vital nerve-centres until large amounts have been inhaled. Ether raises blood-pressure throughout the whole period of anæsthesia, thus differing markedly from chloroform.

USES.—As a general anæsthetic ether is of no value in the horse. The violent struggling and excitement which it causes in this animal, and the difficulty of inducing anæsthesia, even when a large amount of the drug has been inhaled, have led to its use being abandoned.

In the dog, however, it proves a safe anæsthetic, and for this reason is preferred by some practitioners to chloroform; but it is very troublesome to administer, and often large quantities are required to induce anæsthesia. It may, however, be combined advantageously with chloroform in the production of anæsthesia in the dog. In administering ether, its highly inflammable nature must be remembered.

The use of ether as an anæsthetic is contra-indicated in cases

of chronic bronchitis, and in operations in the region of the mouth and throat.

As a stimulant, ether may be administered by hypodermic injection in collapse depending on hæmorrhage or on exhausting disease. As its action is evanescent, it requires to be repeated at intervals.

As an antispasmodic and carminative, combined with other agents, ether is useful in gastric tympany in the horse. It is necessary to administer the drug in oil or mucilage, so that its irritating effect in the mouth may be prevented.

As a *local anæsthetic*, the ether spray has not proved serviceable in veterinary practice.

COLLODIUM.

Collodium Flexile (Collod. Flex.).—Pyroxylin, 2; Colophony, 3; Castor Oil, 2; Alcohol, 90 per cent., 24; Ether, 69.

Characters.—A colourless, inflammable, syrupy liquid with ethereal odour.

When painted upon the dry skin, the ether and alcohol quickly evaporate and leave a fine film. To this the collodion may be repeatedly applied until a film of the desired thickness is obtained.

Collodion is useful as a protective dressing to abrasions, and for the purpose of sealing and protecting aseptic surgical wounds. It may be combined with such agents as iodoform, carbolic acid, and orthoform.

CHLORALIS HYDRAS.

Chloralis Hydras (Chloral. Hydr.).—Chloral Hydrate; Trichlor-ethylidene-glycol; $\text{CCl}_3\text{CH}(\text{OH})_2$.

Source.—Made by adding water to liquid chloral, $\text{C}_2\text{Cl}_3\text{HO}$. Chloral, an oily liquid, is made by saturating ethylic alcohol with dry chlorine gas, and purifying.

Characters.—Colourless monoclinic plates, non-deliquescent; odour pungent, not acrid; taste pungent, rather bitter. M.p. 49° to 53°C . *Solubility*.—1 in less than 1 of distilled water, alcohol 90 per cent., or ether; 1 in 3 of chloroform; aqueous solution neutral or slightly acid. *Incompatibles*.—All alkalies, which decompose it, liberating chloroform. *Impurities*.—Free chlorides; chloral alcoholate; other organic substances.

Doses.—Horses and cattle, ʒss. to ʒii. ; sheep and pigs, ʒss. to ʒii. ; dogs, grs. v. to grs. xx. The drug can be administered in the form of bolus, draught, or enema. When prescribed as a draught, it should be combined with mucilage, to prevent irritation of the buccal mucosa, or it may be dissolved in water and shaken up with linseed-oil.

ACTIONS.—*Externally*, chloral hydrate possesses powerful antiseptic properties. In concentrated solution it acts as a topical irritant.

Internally, because of its antiseptic properties it is antizymotic, but, unless well diluted, it causes severe irritation of the mouth and stomach. Chloral hydrate is quickly absorbed, and its composition does not undergo alteration in the blood.

It is a central nervous depressant and in full doses is a powerful hypnotic. It exerts anodyne effects by preventing the brain from receiving painful impressions; it has no action on the seat of the pain—*i.e.*, on peripheral nerves. But even in repeated doses chloral hydrate does not interfere with the peristaltic action of the intestines, does not cause nausea, and does not give rise to nervous excitement, all of which actions render opium and morphine undesirable as anodynes in equine practice.

In some horses even a moderate dose (3i.) produces a definite condition of somnolence, while in others the effect of such a dose is slight. The reflexes are depressed, and sensibility to pain is diminished. Chloral hydrate causes depression of the vasomotor centre, a fall of blood-pressure, and dilatation of the bloodvessels throughout the body. It has a direct depressant action on the heart-muscle, resembling that of chloroform. The respiratory centre is depressed and the respirations are slowed.

TOXIC ACTIONS.—In toxic doses, chloral hydrate causes in the horse relaxation of the voluntary muscles, staggering, dilatation of the pupils, lowering of the temperature, and finally a condition of deep stupor. Following the administration of a large dose a brief period of excitement may precede the hypnosis. Death occurs from respiratory failure, but in some instances cardiac depression contributes to the fatal result. The lethal dose for the horse is said to be 4 to 6 ounces administered *per os*.

ANTIDOTES.—Emetics in those animals capable of vomiting, shouting at and beating the patient, strong coffee, hypodermic injection of strychnine five times the ordinary medicinal dose (Winslow), artificial respiration, warmth to surface of body.

MEDICINAL USES.—In equine practice chloral hydrate is largely prescribed as an anodyne, and is the most useful agent we possess for the relief of pain. Chloral hydrate, because of its antizymotic action, is employed in tympanites. An aqueous solution may be shaken up with a pint of linseed-oil, and combined with oil of turpentine in cases in which marked intestinal tympany is present. If desirable, aloes (3v.) in solution may be combined with chloral hydrate (3i.) and oil of turpentine (3ii.), and these form with linseed-oil a very useful draught in colic due to impaction. The combination of camphor with chloral hydrate is

believed to increase its anodyne effect. Chloral hydrate may be repeated at intervals until relief from pain is obtained, and its action does not interfere with that of intestinal stimulants, which it may be desirable to exhibit later.

In conditions characterized by cerebral excitement and convulsions, chloral hydrate is indicated.

In the management of horses which are vicious when being shod or clipped, chloral hydrate in a dose of $\frac{1}{2}$ to $1\frac{1}{2}$ ounces may be dissolved in water and administered by the stomach tube. This treatment is also useful in the case of nervous, excitable, or vicious horses, when it is necessary to place them on an operating-table, or to cast them for surgical operation. The drug should be given about fifteen to thirty minutes prior to operation. The effects are generally very satisfactory, as the preliminary struggling is to a great extent obviated. By the employment of chloral hydrate and a local anæsthetic, many operations can be carried out without the necessity for administering chloroform.

As an anæsthetic, chloral hydrate is largely employed by Continental veterinarians. Various methods of administration are adopted. Cagny administers 2 to 3 grains of morphine, with $\frac{1}{2}$ to 1 grain of atropine by hypodermic injection, and soon afterwards gives 1 ounce of chloral by enema. In about an hour anæsthesia is induced, and is maintained by chloroform inhalation. Hendrickx states that, without producing general anæsthesia, chloral hydrate lessens sensibility, and causes muscular relaxation to an extent sufficient to prevent the patient from struggling. He advises 1 ounce to $3\frac{1}{2}$ ounces of the drug dissolved in 1 pint 15 ounces of water heated to 38° or 40° C., and administered as an enema. The desired effect is produced in from ten to fifteen minutes.

Intravenous injection of chloral hydrate, although it finds favour on the Continent, is now rarely practised in this country.

In canine practice, chloral hydrate combined with bromides was largely employed for the control of the spastic convulsions in puerperal eclampsia in the bitch. The injection of an assimilable salt of calcium, however, usually succeeds in effecting a specific curative response in this condition.

Chlorbutol (Chlorbutol).—'Chloretone'; Chlor-butyl-alcohol; $\text{CCl}_3\text{-(CH}_2)_2\text{OH}$.

Source.—By heating acetone and chloroform with caustic potash.

Characters.—White crystalline flakes; odour and taste musty, camphoraceous. *Solubility.*—1 in 125 of water; readily in alcohol.

Doses.—Horses, ʒii. to ʒiv. ; dogs, grs. v. to grs. x.; cats, grs. ii. to grs. iv.

ACTIONS AND USES.—*Externally*, chlorethane possesses local anæsthetic and antiseptic properties and in combination with boric acid ('boro-chlorethane') proves useful as an antiseptic dressing for wounds and for painful otorrhœa in the dog.

Internally, chlorethane is sedative and hypnotic. In canine practice it is largely employed in the treatment of gastritis and obstinate vomiting because of its action as a gastric sedative and antiseptic. It sometimes proves of value in canine typhus. Chlorethane is best administered in capsule or in the form of powder, placed on the back part of the tongue. It may be repeated at intervals of half an hour until vomiting ceases.

As a hypnotic, chlorethane, in association with local anæsthesia, is useful in canine surgery. It is said to possess but slight depressant effects upon the heart. It may be administered as a preliminary to the induction of general anæsthesia, and, if given about an hour previous to the administration of chloroform, it considerably lessens the period of excitement.

In the cat only minimum doses should be employed, as this animal is very susceptible to its action.

Sulphonal (Suphonal).—*Source.*—May be obtained by oxidizing mercaptol, prepared from acetone and mercaptan.

Characters.—Colourless prismatic crystals, odourless and nearly tasteless; neutral.

Solubility.—1 in 450 of cold, 1 in 15 of boiling, water; 1 in 80 of alcohol 90 per cent.

Sulphonal is a hypnotic, which is absorbed and excreted very slowly. It has no depressant effect on cardiac muscle or on respiration. Hendrickx states that 60 to 80 grammes of the drug given in tepid bran-water twelve hours previous to operation produce in the horse a hypnotic effect sufficient to dull sensibility and to bring about muscular relaxation. The action of sulphonal on the horse may be erratic; in some instances no effect is produced, while in others the animal is unable to maintain the standing posture, and cases are observed in which the hypnotic action is maintained for forty-eight hours.

As a hypnotic for neuroses associated with hyperexcitability in the dog, sulphonal may be prescribed in doses of 10 to 40 grains, to be given in warm milk.

Paraldehydum (Paraldehyd.).—Paraldehyde (CH_3CHO)₃.

Source.—A product of the polymerization of acetaldehyde, CH_3CHO .

Characters.—A clear, colourless liquid; odour characteristic, ethereal; taste acid, afterwards cool. Congeals at low temperatures; m.p. not under 10° C.; sp. gr. 0.998 to 1.0. *Solubility.*—1 in 9 of water, less in hot water; the solution is neutral. Miscible in all proportions with alcohol 90 per cent. and ether.

Paraldehyde is a hypnotic, but is less effectual than chloral hydrate, and is erratic in its action in animals. Further, its obnoxious taste renders it difficult of administration, and it is therefore seldom prescribed in veterinary practice.

Barbiturates.

Within the last few years many derivatives of barbituric acid have been synthesized and their pharmacological properties investigated. The first of these products were used as hypnotics and sedatives, but recently a certain number have been introduced for use as intravenous narcotics and anæsthetics.

Phenobarbitonum (Phenobarbiton.). — Phenobarbitone, Pheno barbital. Phenobarbitone is phenyl-ethyl-barbituric acid.

Source.—It may be obtained by a condensation of ethyl phenyl-ethylmalonate with urea, and is otherwise known as phenylethyl-malonylurea.

Characters.—A white crystalline powder; odourless, tastes slightly bitter; practically insoluble in water.

Doses.—Dogs, gr. ss. to grs. ii.

Phenobarbitonum Solubile (Phenobarbiton. Solub.). — Soluble Phenobarbitone, Soluble Phenobarbital.

Soluble phenobarbitone is a monosodium derivative of phenyl-ethylmalonylurea.

Source.—May be obtained by the interaction of phenobarbitone and sodium hydroxide.

Characters.—White powder; odourless; bitter taste; very soluble in water. (May be obtained in the form of tablets, or as solution ready prepared for subcutaneous injection.)

Doses.—Dogs, gr.ss. to grs.ii.

Phenobarbitone in medicinal doses acts almost entirely on the central nervous system as a sedative and hypnotic. It produces little analgesia. Slightly excessive doses may produce interference with gait and posture, but grossly excessive doses are required to produce other effects, which include a fall in body temperature, a slight lowering of the basal metabolic rate, depression of the respiratory centre and a lowering of blood pressure. The toxic dose is at least twenty times the normal medicinal dose.

Phenobarbitone is now extensively used in canine practice in the treatment of all forms of nervous excitement. The response to the drug is somewhat variable, and to obtain the most beneficial effect it is necessary to adjust the dose to suit the individual case. This can be achieved by administering moderate doses at four-hourly intervals until the desired sedative effect is obtained, and then repeating the dose at longer intervals as may be required. The action of the drug is rather slow, but is prolonged, and in

mild cases a single daily dose is often found sufficient to maintain a satisfactory degree of nervous stability.

The soluble product may be given subcutaneously or preferably intramuscularly in cases of extreme hysteria in which oral administration is impracticable.

Nembutal.—Sodium Ethyl-methyl-butyl-barbiturate. Pentobarbital Sodium (*not official*). Nembutal may be obtained as a white powder or as a solution containing 1 gr. in 1 c.c.

Nembutal is a 'short acting' barbiturate and, given intravenously, has been recently employed as a general anæsthetic in small animal practice. When using nembutal intravenously the dose is not computed in the ordinary way, but more than is sufficient of the drug is made available in a syringe, and the intravenous injection is made slowly until there is produced the required degree of anæsthesia, which persists for from thirty to forty-five minutes. In computing the approximate amount of the drug that will be required to produce anæsthesia in a given animal a basis of $\frac{1}{2}$ gr. for each pound body weight may be adopted. It is essential that the injection should be made very slowly, in order that time may be allowed for the drug to be distributed through the blood stream and taken up by the central nervous system, so that its effect can be observed while the injection is being made. Obviously if the blood stream is suddenly flooded with a full dose of the drug a fatality may result.

If care be taken in making the injection this method of effecting anæsthesia is safe, and obviously is advantageous for operations involving the nose, mouth or throat.

The drug has been used as an anæsthetic for the cat, and also for sheep and pigs.

Pentothal Sodium.—Sodium Ethyl-methyl-butyl-thio-barbituric acid. A product similar in structure to nembutal, except that it contains an atom of sulphur in place of the oxygen atom in the urea molecule.

Characters.—A lemon-coloured powder; bitter taste; smells slightly of sulphur. It is usually available as a powder in sealed ampoules containing definite weights, and is dissolved in distilled water immediately prior to use.

Pentothal sodium differs from nembutal only in that the period of anæsthesia is shorter and the rate of recovery more rapid. Administration is conducted similarly to that employed in the case of nembutal.

Hexobarbitonum Solubile (Hexobarbiton. Solub.).—Soluble Hexobarbitone; Sodium N-methyl-cyclohexenyl-methyl-barbiturate. The sodium salt of hexobarbitone.

Characters.—A white crystalline powder freely soluble in water; the solution is very unstable and must be freshly prepared immediately before use.

Available in sealed glass vials containing 0.5 gramme and 1.0 gramme. The drug is administered in the form of a 10 per cent. solution.

Soluble hexobarbitone injected intravenously produces anæsthesia lasting not more than twenty to thirty minutes. It is employed similarly to the other soluble barbiturates used as anæsthetics.

Nikethamidum (Nikethamid.).—Nikethamide; $C_{10}H_{14}ON_2$.

Source.—May be prepared by the action of thionyl chloride on nicotinic acid and treatment of the resulting acid chloride with diethylamine.

Characters.—A colourless or yellowish oily liquid or crystalline solid; almost odourless; taste faintly bitter followed by a sensation of warmth. Miscible in all proportions with water; readily soluble in alcohol, ether, chloroform and acetone.

Doses.—Dogs, by intravenous or intramuscular injection, grs. iv. to grs. xx.

Nikethamide has been found of value as an antidote to poisoning with the barbiturates. It is usually administered in the form of a 25 per cent. solution.

Amylis Nitris.

Amylis Nitris (Amyl. Nitris).—Amyl Nitrite. A liquid consisting chiefly of Iso-amyl-nitrite, $C_5H_{11}O.NO$, but containing also other nitrites of the homologous series.

Source.—By the interaction of nitrous acid and amylic alcohol which has been distilled between 128° and $132^{\circ}C$.

Characters.—A volatile liquid, of a yellowish colour, fragrant odour, and the faintest acid reaction. Sp. gr. 0.870 to 0.880. Not less than 90 per cent. distils below $100^{\circ}C$. *Solubility.*—In all proportions of alcohol 90 per cent.; almost insoluble in water. *Impurities.*—Amyl nitrate, amyl alcohol, excess of aldehydes and water.

Doses.—Horses and cattle, ℥x. to ℥i.; dogs, ℥i. to ℥v. Administered either as an inhalation, or dissolved in rectified spirit as a draught.

ACTIONS.—Amyl nitrite, if administered by inhalation, enters the tissues rapidly. It has a special action on the circulatory system; it dilates the peripheral bloodvessels by direct relaxation of their muscular walls; the blood-pressure is thus lowered to a marked degree. The action of the heart is accelerated, but its force is only slightly increased (probably the result of depression of the vagal centre due to lowered blood-pressure).

Amyl nitrite depresses the motor tracts of the spinal cord, thus reducing reflex excitability. It causes a transient relaxation of the bronchial muscles. It is believed to have a special action

on the blood, by which it converts a portion of the hæmoglobin into methæmoglobin, and as this does not readily part with oxygen, oxidation is interfered with.

The body temperature falls, due to the diminished oxidation and to the dilatation of peripheral vessels.

TOXIC ACTIONS.—Toxic doses produce muscular weakness, laboured respirations, loss of reflex excitability, a staggering gait, and finally death from asphyxia, which may be preceded by convulsions.

USES.—Amyl nitrite is seldom employed in veterinary practice. As an antidote to the toxic effects of chloroform it is of no value. In spasmodic asthma in the dog it is recommended, and experimentally it has proved an antidote to strychnine-poisoning. It has been tried in tetanus, but not with encouraging results. In hominine medicine it gives marked relief in angina pectoris. This disease is rarely encountered in veterinary practice.

Sodii Nitris (Sod. Nitris).—Sodium Nitrite; NaNO_2 .

Source.—Obtained by fusing sodium nitrate with metallic lead, $\text{NaNO}_3 + \text{Pb} = \text{NaNO}_2 + \text{PbO}$.

Characters.—A white crystalline, deliquescent powder. Taste saline. **Solubility.**—1 in 1.5 of water; the solution neutral or slightly alkaline.

DOSES.—Horses, grs. xx. to ʒss.; dogs, gr. $\frac{1}{2}$ to grs. ii. Repeated every four hours.

Sodium nitrite has actions similar to amyl nitrite; its effects are less rapidly produced, but persist for a longer period.

Trinitroglycerin, Nitroglycerin, or Glonoin Oil, resembles amyl and sodium nitrites in its actions, but is more powerful and persistent. It is official in the form of *LIQUOR GLYCERYLIS TRINITRATIS* (1 per cent.), and is sometimes prescribed for spasmodic asthma in the dog, the dose being $\frac{1}{2}$ to 2 minims well diluted with water.

Spiritus Ætheris Nitrosi.

Spiritus Ætheris Nitrosi (Sp. Æther. Nitrosi).—Spirit of Nitrous Ether; Sweet Spirit of Nitre. An alcoholic solution, containing not less than 1.25 or more than 2.5 per cent. by weight of Ethyl Nitrite, with Aldehyde, and other substances.

Source.—Made by distilling a mixture of alcohol 90 per cent., nitric acid, sulphuric acid, and copper, dissolving the distillate in alcohol, and repeating the distillation with nitric acid, and adding alcohol. Production of *ethyl nitrite and aldehyde*: $3\text{C}_2\text{H}_5\text{OH} + 2\text{HNO}_3 + \text{H}_2\text{SO}_4 + \text{Cu} = 2\text{C}_2\text{H}_5\text{O.NO} \text{ (ethyl nitrite)} + \text{C}_2\text{H}_4\text{O} \text{ (aldehyde)} + 4\text{H}_2\text{O} + \text{CuSO}_4$.

Characters.—A transparent liquid, with a very faint yellowish tinge; peculiar penetrating apple-like odour, and characteristic sweetish, cooling, sharp taste. Slightly acid. Inflammable. Sp. gr.

0.838 to 0.842. *Incompatibles*.—Potassium iodide, ferrous sulphate, the solutions of ammonium acetate, sodium salicylate, antipyrin, tannic acid. *Impurities*.—Excess of aldehyde or acid; deficiency in ethyl nitrite.

Doses.—Horses, ʒi. to ʒiii. ; cattle, ʒii. to ʒiv. ; sheep and pigs, ʒii. to ʒiv. ; dogs, ℥xx. to ʒi.

The smaller doses are those intended to be repeated at intervals. The drug should be properly diluted in order to avoid irritation of the mouth.

ACTIONS.—Spirit of nitrous ether combines the actions of alcohol with those of the nitrites. It is stimulant, antispasmodic, carminative, diuretic, and febrifuge. It accelerates cardiac action, produces dilatation of superficial bloodvessels, lowers arterial pressure, and causes relaxation of involuntary muscles. It is diuretic by dilating the renal bloodvessels, and by a similar action on the cutaneous vessels, as well as by stimulating perspiration, it produces diaphoretic effects, but this action is seldom observed in animals unless the action of the drug be assisted by the application of warm clothing to the body.

USES.—As a diffusible stimulant, it is extensively employed in veterinary practice. In combination with solution of acetate of ammonium, it is useful in the early stages of influenza when rigors are present.

As an antispasmodic and carminative, it is prescribed in spasmodic colic.

As a diuretic, it is useful in cases of chronic renal affections associated with increased arterial tension. It causes a free flushing out of the renal tubules and relaxes spasm of the renal vessels. It is contra-indicated in acute nephritis because of its effects on the renal vessels.

In the primary stages of azoturia, spirit of nitrous ether is frequently administered with benefit. Since the administration of draughts in respiratory affections has been practically abandoned, spirit of nitrous ether is now comparatively seldom employed. Formerly the routine treatment for such conditions consisted in the repeated administration of 'fever draughts,' composed chiefly of sweet spirit of nitre and solution of acetate of ammonia.

Formaldehyde.

Liquor Formaldehydi (Liq. Formaldehyd.).—Solution of Formaldehyde; 'Formalin'; Solution of Formaldehyde is an aqueous solution containing in 100 ml. not less than 37 and not more than 41 g. of Formaldehyde, $\text{H}\cdot\text{COH}$.

Source.—May be obtained by the limited oxidation of methyl alcohol.

Characters.—A colourless liquid; odour characteristic, pungent; neutral or slightly acid; caustic to the skin. Sp. gr. 1.079 to 1.081. Miscible with water and with alcohol 90 per cent. in all proportions. Yields on evaporation a whitish amorphous residue (paraformaldehyde) which leaves no ash on incineration. Precipitates silver from solution of silver ammonio-nitrate; gives with sulphuric acid containing salicylic acid a deep-red coloration. *Impurities.*—Acetone, iron, copper, lead, calcium, chlorides, and sulphates.

Doses.—Horses and cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{i.}$ freely diluted in saline and administered by stomach tube.

ACTIONS.—Formalin coagulates albumin and is antiseptic, disinfectant, and deodorant. If undiluted it is a powerful caustic and an irritant. Its vapour is very irritating to the eyes and respiratory passages, and it has a corrosive action on surgical instruments. It is a powerful antizymotic, but in excessive doses it is an irritant poison, causing acute gastritis and subsequent collapse.

USES.—*Externally*, its caustic and irritant properties preclude its general use as a surgical dressing, but aqueous solutions of 1 in 2,000 to 1 in 1,000 are occasionally employed for this purpose. Stronger solutions (1 in 500) have been found of service in foetid seborrhœa, but they are very irritant, and their application requires great care. A 2 per cent. solution is sometimes employed as an injection in the treatment of sinuses and fistulæ. Stronger solutions should not be employed, as they are likely to cause extensive destruction of tissue. In the treatment of ringworm a 2 per cent. solution has been found useful.

Internally, in cases of recurring tympanites in cattle, which do not depend upon the presence of a foreign body in the reticulum or upon organic disease, the internal administration of formalin gives excellent results; 6 drachms diluted with 1 to 2 gallons of a 2 or 3 per cent. saline solution may be given daily by stomach tube. In the post-parturient acetonæmia of cows associated with gastric derangement (post-parturient dyspepsia). 2 drachms of formalin with 1 drachm of liquid extract of nuxvomica, mixed in 2 pints of ale, and administered two or three times daily, is commonly followed by prompt recovery. For the use of formalin in pneumonia, see page 433.

Hexamina (Hexamin.).—Hexamine; Hexamethylene-tetramine; Urotropine; Formamine; $(\text{CH}_2)_6\text{N}_4$. Obtained by the action of Ammonia on Formic Aldehyde.

Characters.—Colourless crystals or crystalline powder. Inodorous; taste sweetish, then bitter. *Solubility.*—1 in 1.5 of water, 1 in 8 of alcohol 90 per cent. Aqueous solution alkaline. Partially decomposes at 263°C. ; sublimes without fusing. Heated with dilute H_2SO_4 formic aldehyde is evolved.

Doses.—Horse, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; dog, grs. iii. to grs. v.

Hexamine, when administered *per os*, is rapidly excreted by the kidneys, and when the urine is acid a portion of the drug is split up, yielding free formaldehyde. Hexamine is thus a valuable urinary disinfectant, but is inefficient when the urine is alkaline, as the drug is effective only when the *pH* of the urine is below 6. Hence if the urine be relatively alkaline in reaction sodium acid phosphate should first be given, to render it acid.

Hexamine has been recommended in canine practice as a solvent of uric acid and urates, but there is little evidence of its value in this respect.

Formamol (B.P.C.).—Helmitol; New Urotropine; $C_7H_8O_7(CH_2)_5N_4$. White crystals. Soluble in water (1 in 5), sparingly in alcohol. It is decomposed by acids and alkalies, liberating formaldehyde.

Helmitol is used as a substitute for hexamine. The doses are similar.

TANNOFORM (*not official*) is a condensation product of tannic acid and formaldehyde.

Externally, tannoform is astringent, desiccant, and antiseptic, and is employed as a dry dressing for wounds. In canine practice it is useful in moist eczema and in the treatment of otorrhœa.

Internally, it is an intestinal astringent and antiseptic, and is said to pass through the stomach unaltered. It proves useful in obstinate diarrhœa and intestinal catarrh in foals and calves, the doses being from 30 to 60 grains three times daily, given in linseed gruel or in milk. For the dog, 10 to 20 grains may be prescribed.

Benzenum.—Benzene; Benzol; C_6H_6 (*not official*). A hydrocarbon obtained from light Coal-Tar Oil.

Characters.—A colourless, mobile, inflammatory liquid. Sp. gr. 0.880 to 0.887. Solidifies at 0° C. B.P. 79° to 82° C. Insoluble in water; miscible with alcohol and ether.

Benzene must be distinguished from petroleum benzine, which is obtained from American petroleum and is used for heating thermo-cauterics.

ACTIONS AND USES.—Benzene acts as an irritant when applied to mucous membranes or to skin-abraded surfaces, or if rubbed into the skin; it also possesses antiseptic and parasiticide actions. If administered *per os*, in toxic doses, it produces muscular tremors, loss of sensibility, and convulsions. Combined with three parts of oil or soft paraffin, it is occasionally employed in the treatment of parasitic affections of the skin, such as pediculosis.

Phenazonum (Phenazon.).—Phenazone; 'Antipyrine'; Phenyl-dimethyl-iso-pyrazolone; $C_6H_5(CH_3)_2C_3HN_2O$.

Source.—Obtainable from phenyl-hydrazine by interaction with

aceto-acetic ether and the subsequent interaction of the resulting phenyl-methyl-iso-pyrazolone with methyl iodide.

Characters.—Small, colourless, scaly crystals; odourless; taste bitter. M.p. 111° to 113° C. *Solubility*.—1 in 1.2 of water; 1 in 1.3 of alcohol 90 per cent., or of chloroform. Aqueous solution neutral; gives with HNO_3 a yellow colour turning crimson on warming; green and red on boiling with fuming HNO_3 ; deep red with Fe_2Cl_6 solution. *Incompatibles*.—Spiritus ætheris nitrosi (a bluish-green colour being formed), and other nitrites in acid solution; the alkaloids of cinchona; tannic acid.

Doses.—Horses, ʒii. to ʒiv. ; cattle, ʒiii. to ʒvi. ; sheep and pigs, grs. xxx.; dogs, grs. v. to grs. x. Administered three times daily.

ACTIONS AND USES.—Phenazone is a powerful antipyretic and anodyne. Its antipyretic effect is due to its depressing the heat centre and thus setting the temperature at a lower level. As a result an increase in heat dissipation occurs, and this is effected by dilatation of the superficial capillaries. By reducing sensibility to painful impressions and diminishing reflex activity it is anodyne. The drug passes through the body unchanged, and is thus less toxic than acetanilide, which is converted into the toxic para-amido-phenol. Toxic doses cause convulsions resembling those produced by strychnine, followed by serious depression of the vital centres and collapse.

Phenazone is frequently prescribed in specific fevers. It is said to prove of value in acute laminitis.

Acetanilidum.—Acetanilide; Phenyl-acetamide; $\text{C}_6\text{H}_5\text{NH}(\text{CH}_3\text{CO})$; 'Antifebrin' (not official).

Source.—Obtainable by the interaction of glacial acetic acid and aniline.

Characters.—Colourless, glistening, lamellar crystals; odourless; taste slightly pungent; melts at 113° C. *Solubility*.—1 in 210 of water; 1 in 4.2 of alcohol 90 per cent.; freely in ether and chloroform. Aqueous solution with Br solution gives yellowish-white precipitate. *Impurities*.—Free acid, phenazone, and salts of aniline.

Doses.—Horses and cattle, ʒss. to ʒii. ; sheep and pigs, grs. x.; dogs, grs. i. to grs. v. Administered three times daily.

ACTIONS AND USES.—Acetanilide possesses marked antipyretic and anodyne actions. Unlike antipyrine, it is readily converted into para-amido-phenol, and hence is more toxic than the former agent. It induces the formation of methæmoglobin in the substance of the red blood-corpuscles, with resultant anoxæmia. Toxic doses produce a weak, thready pulse, laboured respirations, convulsive movements, cyanosis, and collapse.

Acetanilide is prescribed in specific fevers accompanied by high temperature, and may be given as a bolus or in an electuary. Because of the depressant action of both phenazone and acetanilide, these drugs are contra-indicated in febrile conditions which are accompanied by cardiac weakness.

Phenacetinum (Phenacet.).—Phenacetin; Para-acet-phenetidín; $C_2H_5O.C_6H_4.NHCOCH_3$.

Source.—Produced by the interaction of glacial acetic acid and para-phenetidín, obtained from para-nitro-phenol.

Characters.—Small, colourless, glistening scaly crystals; odourless; tasteless, neutral. *Solubility.*—Very sparingly in cold, more freely in boiling, water; 1 in 21 of alcohol 90 per cent. Melts at $135^{\circ}C$. Boiled with HCl and then diluted, gives a deep red colour with chromic acid solution. *Impurities.*—Acetanilide and para-phenetidín.

Doses.—Horses, \mathfrak{z} ii. to \mathfrak{z} iv.; cattle, \mathfrak{z} iii. to \mathfrak{z} vi.; sheep and pigs, grs. xxx.; dogs, grs. v. to grs. x. Administered three times daily.

ACTIONS AND USES.—Phenacetin is an antipyretic and analgesic. It is the safest of the coal-tar antipyretics, for, while its action depends upon its conversion into para-amido-phenol, its insolubility retards its decomposition, and its effects are more slowly produced, more prolonged, and less toxic than those of acetanilide. It is less depressant to the heart than either acetanilide or phenazone. It is occasionally employed as an antipyretic in equine practice.

Resorcinol (Resorcin.).—Resorcin; Meta-dihydroxy-benzene; $C_6H_4(OH)_2$.

Source.—By the action of fused sodium hydroxide on sodium metabenzene disulphonate.

Characters.—Acicular or prismatic colourless crystals, odour faint; taste pungent, sweetish, later bitter. *Solubility.*—1 in 1 of water or alcohol; soluble in ether, glycerin, and olive oil.

ACTIONS AND USES.—Resorcin in a 5 per cent. solution is antiseptic, parasiticide, and keratolytic, but is usually employed as an ointment (1 in 8) in the treatment of chronic eczema and psoriasis. It is also employed as an intestinal antiseptic in diarrhoea in foals and calves, the dose being from 20 to 40 grains.

Salol.—Salol; Phenyl Salicylate; $C_6H_4.OH.COOC_6H_5$ (*not official*).

Source.—Made by the interaction of salicylic acid and phenol.

Characters.—Colourless crystals, or crystalline powder; odour aromatic, taste slight. *Solubility.*—Almost insoluble in water; 1 in 15 of alcohol 90 per cent. (solution neutral); 3 in 1 of ether or chloroform; and in fixed and volatile oils. Gives a white precipitate with Br solution and a violet colour with Fe_2Cl_6 solution. *Impurities.*—Free salicylic acid, sulphates and chlorides.

Doses.—Horse, \mathfrak{z} ii. to \mathfrak{z} iv.; dog, grs. iii. to grs. x.

Externally, salol has been used as a substitute for iodoform.

Internally, salol remains unaltered in the stomach, but in the alkaline duodenum it is split into phenol and salicylic acid, and therefore possesses the combined actions of these drugs.

Salol is an antipyretic, antiseptic, and intestinal disinfectant. It is occasionally prescribed in diarrhoea depending on excessive

fermentation in the intestines. As it liberates salicylic acid, salol is also antipyretic.

Trypanblue or Trypanblau (*not official*)—

A complex substance derived from toluidine and sodium amidonaphthol sulphonate.

Trypanblue has been employed in the treatment of canine and bovine piroplasmosis. In canine piroplasmosis Nuttall employed a 1 to 5 per cent. solution of trypanblue in cold sterilized water, the dose being for small dogs 2 c.c. and for large dogs 15 c.c., administered by intravenous injection; subcutaneous injection is, however, likely to be followed by abscess formation and sloughing of the skin. As a result of the administration, all the tissues are stained blue. In the treatment of leptospiral jaundice in dogs, as met with in this country, the drug has not proved successful. For cattle the dose of a 1 per cent. solution is 150 to 200 c.c.

Naphthalene—Tar Camphor (*not official*)—

A hydrocarbon obtained by the distillation of coal tar. Occurs as white shining crystals of a strong coal-tar odour and pungent taste. Insoluble in water, soluble in alcohol, ether, and chloroform.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} iii.; calves, \mathfrak{z} ss. to \mathfrak{z} i.; sheep and pigs, grs. x to grs. xx; dogs, grs. ii. to grs. x. Administered in mucilage or castor-oil.

ACTIONS AND USES.—*Externally*, naphthalene is an antiseptic and parasiticide, and may be employed for the destruction of skin parasites in the form of a 10 per cent. ointment.

Internally, in diarrhoea and dysentery it may be prescribed as an intestinal antiseptic; it is also advised as a vermicide.

Betanaphthol (Betanaph.).—Naphthol; Beta-mono-hydroxynaphthalene; $\text{C}_{10}\text{H}_7\text{OH}$.

Source.—May be prepared from naphthalene-sulphonic acid.

Characters.—White, or nearly white, crystalline lamellæ, or in powder; odour like phenol; taste sharp, pungent. M.p. 122°C . **Solubility.**—1 in 1,000 of cold, 1 in 75 of boiling, water, solutions neutral; in less than 2 of alcohol 90 per cent.; very soluble in ether or chloroform.

Externally, it is sometimes employed in the treatment of scabies, eczema, and psoriasis, in the form of ointment—*e.g.*, 1 to 8 of prepared lard or lanolin.

Internally, naphthol is occasionally used as a vermifuge and as an intestinal antiseptic, the dose for the horse being from \mathfrak{z} i.ss. to \mathfrak{z} ii., and for the dog from grs. iii. to grs. x. It should be given in the form of an emulsion or in keratin capsules, as the drug is irritant to the stomach.

Scarlet Red (*not official*).—A complex substance derived from coal tar.

In the form of a 4 per cent. ointment this agent has been found useful in surgery as a dressing for ulcerated surfaces. The ointment is spread on gauze and applied to the part by means of a bandage. It should not be left on longer than forty-eight hours, or marked irritation may occur.

Acriflavina (Acriflavin).—Acriflavine. Acriflavine is a mixture of the hydrochlorides of diamino-methyl-acridinium chloride and diamino-acridine.

Source.—May be prepared by the partial methylation of diacetyl-diaminoacridine and subsequent hydrolysis of the product with hydrochloric acid.

Characters.—An orange red to red crystalline powder; odourless; taste acid. *Solubility*.—1 in 3 of water; insoluble in ether, chloroform, fixed and volatile oils, and in liquid paraffin.

In practice aqueous solutions of acriflavine should be prepared with distilled water.

Acriflavine is a slowly acting antiseptic (1 in 200,000 kills staphylococcus in twenty-four hours, but 1 in 20,000 is required to kill this organism in two hours); it possesses a germicidal power of 80 as compared with carbolic acid when tested against staphylococcus in water, but this is increased to 800 when the test is made in water containing 10 per cent. of serum.

Tetanus spores may survive exposure to a 1 per cent. solution of acriflavine for several weeks. Acriflavine exerts effective antiseptic action on wounds in concentrations much lower than those which produce irritation of the tissues or even interference with phagocytic activity; it is also practically non-toxic, and for these reasons is particularly valuable in small animal practice (1 in 2,000 solutions).

Aqueous solutions of acriflavine (1 in 10,000) are employed as mammary infusions in streptococcal mastitis in cows; the treatment is, however, practicable only in the case of non-lactating milch cows or in those completing a lactation. The infusion should be warmed to body temperature (p. 478).

Brilliant Green (*not official*).—A complex substance derived from coal tar

Used in solutions of 1 in 1,000 to 1 in 500 in normal saline, brilliant green is a non-toxic and non-irritant antiseptic. Brilliant green has a phenol coefficient of 40,000, but its action is very markedly reduced in the presence of organic matter. Since it stains damaged tissue more deeply than normal tissue, it is employed as a means of determining the extent to which wound tissues have been injured.

Chinosol (*not official*) is a coal-tar derivative. It occurs as a yellow crystalline powder of saffron-like odour readily soluble in water, slightly soluble in alcohol, insoluble in ether.

A solution of 1 in 1,000 to 1 in 500 forms a useful antiseptic wound dressing. As chinosol is only slightly irritant and comparatively non-toxic it is commonly employed for wounds in mucous surfaces.

Chinosol in the form of powder has proved useful in the treatment of traumatic septic arthritis and open tendon sheaths.

TOXIC ACTIONS.—Hobday found that the cat is susceptible to its toxic actions, either by application of solutions to the skin or by oral administration. It is not rapidly absorbed from the unbroken skin of the dog. The toxic symptoms observed were 'sneezing, coughing, a flow of ropy saliva from the mouth, subnormal temperature, staggering gait, loss of motor power, commencing in the hind extremities, prostration, and death from cardiac failure.'

Orthocaina (Orthocain).—Orthoform. A white crystalline powder, tasteless and odourless, only very slightly soluble in water.

Orthoform is an antiseptic and a local anæsthetic when applied to abraded surfaces (as a 10 to 20 per cent. ointment or dusting powder). The anæsthetic action is usually prolonged. It is used in canine practice as a dressing for irritable wounds, as it allays irritation and pain. It is also useful as a dressing to painful lesions such as burns and scalds, and to relieve the irritation which accompanies some forms of eczema.

Fluoresceinum Solubile (Fluoresc. Solub.).—Soluble Fluorescein. The di-sodium salt of fluorescein, prepared by the condensation of resorcinol and phthalic anhydride.

Characters.—An orange-red powder. **Solubility.**—1 in 1 of water.

When fluorescein is instilled into the eye, corneal ulcers become green in colour, and their presence is thus more readily determined. For this purpose, fluorescein is used as a 2 per cent. aqueous solution, to which 3 per cent. sodium bicarbonate is added.

Phenol.

Phenol (Phenol).—Carbolic Acid.

Source.—May be obtained from coal-tar oil.

Characters.—Small, colourless, deliquescent crystals; odour peculiar, not fetid or tarry; taste sweetish, pungent. Is caustic to skin and mucous membranes. Exposed to moist air, may become pinkish. **Solubility.**—100 parts are liquefied by 10 parts water; form a clear liquid with 30 to 40 parts water; and completely dissolve in 1,200 parts water. Freely soluble in alcohol 90 per cent., ether, chloroform, glycerin, in fixed and volatile oils, and in solutions of alkalis. M.p. 39° to 40° C. B.p. 183° C. Sp. gr. 1.060 to 1.066. Does not at

once reddened blue litmus. Precipitates solution of albumin and colloidion. Solutions give deep purple with Fe_2Cl_6 ; a white precipitate with Br solution. *Impurity*.—Cresol.

Phenol Liquefactum (Phenol. Liq.).—Liquefied Phenol; 'Liquefied Carbolic Acid'; Phenol, 80 g.; Water to 100 g.

Characters.—A liquid, colourless at first, changing to pinkish. Sp. gr. 1.067 to 1.069. Forms a clear solution on addition of 12 to 20 per cent. of water.

Doses.—Horses, ℥xv. to ℥xl.; cattle, 3ss. to 3i.; sheep and pigs, ℥v. to ℥x.; dogs, ℥i. to ℥ii. It should be properly diluted with water, and if a little glycerin be added it is less liable to cause irritation.

For disinfecting purposes various preparations of crude carbolic acid are employed. 'No. 4' carbolic acid contains 10 per cent. of phenol and nearly 90 per cent. of cresols; 1 in 40 of hot water forms a suitable disinfectant fluid. 'No. 5' carbolic acid is dark-coloured, and consists chiefly of cresylic acid. It is used for disinfecting buildings, drains, etc.

The liquefied phenol (B.P.) is used for medical and surgical purposes.

Glycerinum Phenolis (Glycer. Phenol.).—Glycerin of Phenol; Phenol, 20; Glycerin to 100.

Unguentum Phenolis (Ung. Phenol.).—Phenol Ointment; Phenol, 3; Paraffin Ointment, White, 97.

CARBOLIC SOAPS contain from 10 to 20 per cent. of phenol.

CARBOLIC ANTISEPTIC DRESSINGS—

CARBOLIC ABSORBENT WOOL AND LINT contain from 5 to 10 per cent. of phenol. CARBOLIC GAUZE contains 5 per cent. CARBOLIC TOW contains from 5 to 10 per cent. CARBOLIC DISINFECTING POWDERS contain from 20 to 30 per cent. of carbolic acid.

ACTIONS.—*Externally*, phenol causes precipitation of proteins and is a protoplasmic poison. It, however, does not enter into combination with proteins and therefore penetrates deeply. It is thus an antiseptic and, in concentrated form, a caustic, producing a white eschar which later becomes brown in colour. It also produces local anæsthesia of the part to which it is applied. Carbolic acid in a 1 per cent. solution destroys putrefactive and pyogenic organisms, while solutions of 5 to 10 per cent. are capable of destroying spores. Exposure to a 5 per cent. solution for two days is, however, necessary for the destruction of anthrax spores. The antiseptic action of phenol is quickly lost in the presence of organic matter.

Internally, carbolic acid exerts antiseptic effects. If inhaled with water vapour, it is antiseptic and analgesic to the respiratory mucous membrane. In medicinal doses it is a gastric and intestinal antiseptic and antizymotic.

TOXIC ACTIONS.—In large doses carbolic acid is an irritant narcotic poison. It can be absorbed from the unbroken skin, from wounds, and from mucous surfaces.

The symptoms observed in the horse are: presence of white eschars in the mouth, salivation, muscular tremors, a staggering gait, accelerated respirations, coldness of the surface of the body and extremities, and convulsions, succeeded by paralysis and coma.

In the dog, vomiting and symptoms of intoxication may first appear, succeeded by a state of collapse, death occurring either from respiratory or cardiac paralysis. The urine assumes a characteristic olive-green or brown colour, due to the presence of oxidation products.

Carbolic acid poisoning in animals may occur as a result of the absorption of the drug from wounds, and from the surface of the skin. The dog is specially susceptible to its toxic effects from skin absorption. Fatal cases have occurred in cats when strong carbolic disinfecting powder has been liberally applied to the floors of buildings to which these animals had access, the poison probably entering the body by the animals licking their paws.

Post-Mortem.—Characteristic white eschars in mouth, cesophagus, and stomach. Blood dark, and coagulates imperfectly. Fatty degeneration of liver and kidneys may be present, and if death has occurred within twenty-four hours, the characteristic odour of the drug can be detected throughout the body.

One ounce of carbolic acid has proved fatal to the horse, and 15 grains have caused fatal poisoning in the dog.

ANTIDOTES.—In the dog emetics should be given, preferably the hypodermic injection of apomorphine. Local emetics frequently fail, because of the local anæsthetic effect of the drug on the stomach. In all animals sulphate of magnesium and sulphate of sodium are suitable antidotes, as they convert carbolic acid into sulphocarbolates, which are inert and are excreted by the kidneys. Sulphate of sodium injected hypodermically is advised. Olive-oil and lime-water should be given freely; should collapse be threatened stimulants are indicated.

The irritation of the mouth and pharynx is treated with demulcent drinks and medicated inhalations. To combat the escharotic effects of the drug the application of pure alcohol is advised, as solutions of carbolic acid in strong alcohol or concentrated glycerin are not caustic, but may become so when diluted with water.

USES.—*Externally*, as an antiseptic agent for general surgical work, carbolic acid is still extensively used, but antiseptic agents

which are less irritating and less toxic are now generally preferred. The usual strength of carbolic solutions for surgical purposes is from 1 to 2½ per cent.

Carbolic oil is prepared by combining phenol with olive-oil in varying proportions (1 in 10 to 1 in 20). This preparation is not reliable as a germicide.

Dips containing carbolic acid are largely employed in the treatment of sheep-scab.

Crude carbolic acid is used for the disinfection of animal houses, but in consequence of its poisonous nature other agents are preferable.

Internally, carbolic acid is prescribed as an internal antiseptic and antizymotic. It is employed in combination with other agents in the treatment of dysentery, in flatulent colic in the horse, and in tympanites of the rumen in cattle.

The inhalation of water vapour medicated with carbolic acid is employed in respiratory affections which tend to assume a septic character.

In the treatment of parasitic bronchitis in calves, carbolic acid in doses of 10 minims is prescribed in the form of intra-tracheal injections; for this purpose it is usually combined with 2-drachm doses of the oil of turpentine, 20 grains of carbonate of potash, and 1 drachm each of olive-oil and water.

In consequence of the susceptibility of the dog to the action of carbolic acid, extreme caution is necessary in its employment in canine practice.

There has been recently introduced a group of antiseptics which contain a halogen derivative of xylenol dissolved in a mixture of essential oils. Xylenol is one of the colourless crystalline compounds, $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{OH}$, resembling phenol. The essential oils are dissolved in a neutral solution of soap to make them readily miscible with water, with which they form a uniform opalescent emulsion.

They are stated to possess germicidal powers three times those of carbolic acid and one and a half times those of liquor cresol saponatus. The germicidal power is retained in the presence of pus, blood, serum, and mucus. These compounds are practically non-toxic and do not irritate the tissues even in high concentrations. Concentrations of from 1 to 10 per cent. in water are used as antiseptic solutions.

Creosotum.

Creosotum (Creosot.).—Creosote. A mixture of Phenols, consisting chiefly of Guaiacol and Creosol.

Source.—Obtained by the distillation of wood tar.

Characters.—A colourless or pale yellow, highly refractive liquid; neutral or faintly acid; odour strong, empyreumatic; taste acrid. Sp. gr. not below 1.080. B.p. 200° to 220° C. *Solubility.*—1 in 150 of cold, more so in hot, water; freely in alcohol 90 per cent., ether, chloroform, glacial acetic acid and glycerin. *Impurities.*—Phenol; less volatile liquids. *Incompatible.*—Oxide of silver.

Composition.—Creosote is not a simple body, but a variable compound of *guaiacol*, $C_7H_8O_2$, *creosol*, $C_8H_{10}O_2$, and other phenols. Guaiacol may amount to 20 per cent. in good specimens of creosote.

Doses.—Horses, ℥xx. to ʒi.; cattle, ʒi. to ʒii.; sheep, ℥xv.; pigs, ℥v. to ℥xv.; dogs, ℥i. to ℥v.

The drug should be administered in the form of emulsion, and mixed with milk or oil.

Unguentum Creosoti.—Creosote Ointment (*not official*); Creosote, 10; Hard Paraffin, 40; Soft Paraffin, White, 50.

ACTIONS AND USES.—*Externally*, creosote when undiluted is an irritant and caustic; it coagulates albumin, and forms a white eschar on skin and mucous membrane. It resembles carbolic acid in its actions, but is less poisonous and a more active germicide. It possesses marked germicidal and deodorant properties.

It is commonly employed as a parasiticide, and is especially valuable in the demodectic mange of the dog. It may be used in the form of the ointment or as a liniment composed of 1 part creosote in 12 parts methylated spirit.

Horses and cattle while at grass not infrequently receive slight wounds, and a dressing composed of a mixture of creosote, terebene, and a bland fixed oil is not only antiseptic, but acts as a mechanical protective from the attacks of flies, while being also repellent to these insects.

Internally, creosote is prescribed in obstinate cases of diarrhoea and dysentery in combination with other agents. It acts as a gastro-intestinal disinfectant and checks fermentation. In some cases of obstinate vomiting in dogs it gives relief, but other agents are preferable. It may be used as an inhalation in septic pneumonia. Administered by intratracheal injection, it is employed in the treatment of parasitic bronchitis in calves in the form of an emulsion, the dose being from 5 to 10 minims.

TOXIC ACTIONS.—Toxic doses produce effects which resemble those of carbolic acid, and the antidotal treatment is similar to that for carbolic acid (*q.v.*).

Cresol (Cresol).—Cresol. A mixture of isomers of the formula $\text{CH}_3\text{C}_6\text{H}_4\text{OH}$ obtained from coal tar. Should be preserved in amber-coloured stoppered bottles.

Characters.—A straw-coloured liquid, becoming brown on keeping or on exposure to light. Sp. gr. 1.040 to 1.050. B.p. 195° to 205° C. **Solubility.**—1 in 50 of water, solution neutral; freely in alcohol 90 per cent.; in ether, chloroform, glycerin, and in fixed and volatile oils. Shaken with water and filtered, filtrate gives transient bluish colour with Fe_2Cl_6 solution. **Impurities.**—Phenol, hydrocarbon oils.

Liquor Cresolis Saponatus (Liq. Cresol. Sap.).—Solution of Cresol with Soap; Lysol; Cresol, 50; Linseed Oil, 18; Potassium Hydroxide, 4.2; Water to 100.

Creolin (not official).—

Obtained from coal tar, is a mixture of cresols, and occurs as a dark brown syrupy liquid. It forms a white emulsion when mixed with water. The well-known *Jeyes' Fluid* contains it.

Cyllin (not official).—

Is a purified form of creolin.

ACTIONS.—All these agents are antiseptics, disinfectants, parasiticides, and deodorants; while possessing higher germicidal powers than carbolic acid, they are less toxic and less irritant to the tissues. Like carbolic acid, they rapidly lose their antiseptic power when in contact with organic matter.

TOXIC ACTIONS.—Creolin, when applied in a concentrated form to the skin of dogs and cats, is absorbed, and acts as an irritant poison; in these animals only dilute solutions can be used with safety.

ANTIDOTES.—When the toxic effects are due to the application of an external dressing in the dog the skin should be thoroughly washed with hot water containing sulphate of magnesium. Diffusible stimulants should be administered internally at frequent intervals, the patient being well wrapped up and kept warm.

USES.—*Externally*, as surgical antiseptics, the cresol preparations are used in the form of $\frac{1}{2}$ to 2 per cent. solutions in water.

In the treatment of pediculosis creolin is largely used, and may be combined with other agents. Care should be taken that it is properly diluted.

As a general disinfectant and deodorant for stables, cowsheds, kennels, and drains, creolin is effectual, economical, and safe. Dips containing creolin are commonly employed in the treatment of mange or scab in sheep. The usual strength of solutions for parasitic affections of the skin is from 1 to 2 per cent., and glycerin or soft soap may be added with advantage.

Internally, cyllin in doses of ʒii. to ʒvi. is prescribed in

gastric tympany in horses and cattle, and is usually combined with other agents. It should be administered in a bland vehicle in order to avoid irritation.

Iodoformum.

Iodoformum(Iodof.).—Iodoform; Tri-iodomethane; CHI_3 .

Source.—Produced by the action of iodine on ethylic alcohol in the presence of solution of potassium carbonate. $\text{C}_2\text{H}_5\text{O} + 4\text{I}_2 + 3\text{K}_2\text{CO}_3 = \text{CHI}_3 + \text{KCHO}_2 + 5\text{KI} + 2\text{H}_2\text{O} + 3\text{CO}_2$.

Characters.—Small, shining, lemon-yellow, hexagonal crystals, somewhat unctuous to the touch; odour and taste persistent, disagreeable. **Solubility.**—Very slightly in water; 1 in 100 of alcohol 90 per cent.; 1 in 8 of ether; also in chloroform, carbon disulphide, or fixed and volatile oils. Solutions neutral. It contains more than 90 per cent. of iodine. **Impurities.**—Soluble yellow colouring matters, picric acid, iodides, etc.

Unguentum Iodoformi.—Iodoform Ointment (*not official*); 1 in 10, with Prepared Lard.

Collodium cum Iodoformo (*not official*)—Iodoform Collodion—

Iodoform, 1; flexible collodion, 12.

Bismuth and Iodoform Paste ('Bipp') (*not official*)—

Bismuth subnitrate, 1; iodoform, 2; in liquid paraffin to form a thick paste.

IODOFORM GAUZE contains 5 to 10 per cent. of iodoform.

IODOFORM WOOL contains 10 per cent. of iodoform.

ACTIONS AND USES.—When applied to a wound, iodoform is decomposed by the alkaline fluids and the proteins, and exerts antiseptic and slight local anæsthetic effects. Its action as an antiseptic depends upon its decomposition and the liberation of free iodides, which, however, are liberated slowly and do not act as irritants. The action of iodoform is therefore prolonged and bland.

Toxic symptoms are seldom observed in the larger animals as the result of absorption of iodoform from surgical dressings.

In the dog, care is necessary in order to prevent the animal from licking parts which have been dressed with iodoform. The *toxic symptoms* observed in these cases are vomiting, drowsiness, muscular tremors, and cardiac depression.

Iodoform is chiefly used in the treatment of infected wounds and ulcers and in the disinfection of cavities. It may be applied in the form of a dusting-powder either alone or combined with boric acid.

In the treatment of chronic nasal discharge in the horse, after surgical measures have been adopted, iodoform may be applied as a dressing to the interior of the affected air sinuses.

A combination of iodoform, zinc oxide, and boric acid forms an excellent application for the treatment of acute otorrhœa in the dog. A similar combination is of value as a dry dressing for fissured heels in the horse. Iodoform powder, rubbed gently into the affected parts of the skin, is a useful remedy in the early stages of seborrhœa in the horse.

In thrush of the horse's foot equal parts of iodoform and calomel may be employed.

'Bipp' has proved a valuable antiseptic agent. Septic wounds, if cleansed, swabbed with 'Bipp,' and bandaged, frequently heal without further dressing.

Iodoform collodion is employed as a protective covering to superficial wounds and to operation wounds, as it assists healing by first intention.

Iodoform also forms a useful constituent of uterine pessaries.

In the treatment of septic metritis, some practitioners, after thoroughly flushing out the uterus, advise the application of a 1 in 4 iodoform ointment to the interior of the organ.

In consequence of its tendency to promote excessive granulations in wounds, other agents are preferred to iodoform for general surgical purposes.

Iodoform is not used internally in veterinary practice.

Paraffina.

Paraffinum Durum (Paraff. Dur.).—Hard Paraffin. A mixture of solid hydrocarbons.

Source.—Obtained by distillation from shale, separation of the liquid oils, and purification of the solid product.

Characters.—Colourless, translucent, crystalline, inodorous and tasteless, wax-like, slightly greasy to the touch. M.p. 50° to 60° C. Sp. gr. 0.82 to 0.94. Burns with a bright flame, leaving no ash.

Paraffinum Molle Album (Paraff. Moll. Alb.).—White Soft Paraffin.

Paraffinum Molle Flavum (Paraff. Moll. Flav.).—Yellow Soft Paraffin. Yellow soft paraffin is a mixture of semi-solid hydrocarbons obtained from petroleum. White soft paraffin is the bleached product.

Source.—Usually obtained by purifying the less volatile portions of petroleum.

Characters.—White or yellow, translucent, soft, unctuous to the touch; odourless; M.p. 40° to 46° C.

Paraffinum Molle is contained in many ointments.

Paraffin is non-irritating to the skin and mucous membranes. It does not oxidize or become rancid. It is not readily absorbed, and is therefore employed as an ointment basis for agents intended to produce only a local action on the skin. Soft paraffin combined with antiseptic agents is employed as a lubricant for surgical instruments.

Hard paraffin is used in pharmacy for the purpose of stiffening ointment bases.

Unguentum Paraffini (Ung. Paraffin.).—Paraffin Ointment; White Beeswax, 2; Hard Paraffin, 8; Soft Paraffin, 90.

Paraffin ointment is firmer in consistence than soft paraffin, and is commonly used as an ointment basis.

Unguentum Simplex (Ung. Simp.).—Simple Ointment. Wool Fat, 5; Hard Paraffin, 10; White Soft Paraffin or Yellow Soft Paraffin, 85.

When Simple Ointment (or Paraffin Ointment) is used in a white ointment, it should be prepared with white soft paraffin; and when used in a coloured ointment, it is prepared with yellow soft paraffin.

Unguentum Aquosum (Ung. Aquos.).—Hydrous Ointment, contains Distilled Water, Borax, White Beeswax, White Soft Paraffin, and Olive Oil.

The Simple Ointment and the Hydrous Ointment are employed as emollients and as ointment bases.

Paraffinum Liquidum (Paraff. Liq.).—Liquid Paraffin. A mixture of liquid hydrocarbons.

Source.—Obtained from petroleum after the removal of the more volatile portions by distillation.

Characters.—Transparent, colourless, non-fluorescent; odourless and tasteless. Sp. gr. 0.860 to 0.890.

Doses.—Horses and cattle, O.i. to O.ii.; dogs, ʒi. to ʒi.

Liquid paraffin is a bland laxative acting partly by rendering the fæces softer and partly as an intestinal lubricant. Externally it has the actions of an emollient and protective.

Liquid paraffin is a very useful agent in the treatment of intestinal obstruction or habitual constipation in the dog. It is not absorbed, and passes through the bowel unaltered.

Liquid paraffin is also employed as a basis for applications to the skin and for antiseptic liniments, and as a lubricant for surgical instruments.

Paraffin-Oil, or lamp paraffin (*not official*), if applied to the skin with friction, is an irritant. Diluted with olive-oil, it has been found effective as a dressing for follicular mange in the dog. For this purpose the refined paraffin-oil should be employed.

Paraffin-oil, in combination with sperm-oil or with a solution of soap, forms an efficient dressing for parasitic mange in the horse. It is also employed in the treatment of ringworm. Unless properly incorporated with the diluent, it is liable to blister the skin, and its application must be made with great care.

Phenolphthaleinum.

Phenolphthaleinum(Phenolphthal.).—Phenolphthalein; Dihydroxy-diphenyl-phthalide, $(C_6H_5OH)_2CO \cdot C_6H_4CO$; 'Purgen,' 'Laxophen.'

Source.—May be obtained by heating phenol with phthalic anhydride and sulphuric acid, and purifying the product.

Characters.—A white or yellowish-white crystalline or amorphous powder. No odour or taste. *Solubility*.—Insoluble in water, soluble in alcohol 90 per cent.; forms an intensely red colour with solution of sodium hydroxide.

Dose.—Dogs, grs. ii. to grs. v.

Phenolphthalein is a purgative, acting as a mild irritant directly on the intestinal mucous membrane; it is tasteless, does not gripe, and is suitable for canine practice. In small repeated doses it is a laxative, and has been found useful in hepatic affections and in chronic constipation in the dog and cat.

Phenothiazinum.

Phenothiazinum.—Phenothiazine (*not official*) is a product of the dye industry prepared from diphenylamine, and is itself the parent substance of the three thiazine dyes, thionol, Lauth's violet, and methylene blue.

Characters.—A fine smooth powder having a pale lemon yellow colour, practically tasteless and practically insoluble in water. When exposed to air and moisture slowly undergoes spontaneous oxidation.

Doses.—Horses, ʒi. to ʒi.ss.; sheep and goats, ʒss. to ʒi.

Phenothiazine has been found to be an effective anthelmintic against the strongyloid parasites of the horse. Horses will take the drug mixed with food and no purgative is necessary. In the body of all animals there is evolved from phenothiazine a dye that is excreted by the kidneys; this stains the urine a deep reddish brown so that the urine has the appearance of that associated with myoglobinæmia. The toxicity of the drug is relatively low; in a very small proportion of cases the horse may show inappetence for a few days. Cattle appear to be more susceptible than are horses and sheep to the toxic effects of phenothiazine.

In sheep the drug is effective in parasitic gastritis, but it is of no value in the treatment of distomiasis or tæniasis. The drug is peculiar in that it appears to be more effective in heavy than in relatively light worm infestations.

The value of phenothiazine in the pig and dog has not yet been extensively investigated, but its action on ascaride worms in these animals is uncertain.

Acidum Hydrocyanicum.

Acidum Hydrocyanicum Dilutum (Acid. Hydrocyan. Dil.).—Diluted Hydrocyanic Acid; Diluted Prussic Acid. An aqueous solution containing 2 per cent. by weight of hydrogen cyanide, HCN.

Source.—Prepared by the interaction of potassium ferrocyanide and diluted sulphuric acid, and subsequent distillation. $2K_4Fe(CN)_6 + 3H_2SO_4 = 6HCN + Fe_2K_2(CN)_6 + 3K_2SO_4$.

Characters.—A colourless liquid, odour characteristic. Sp. gr. 0.997. Faintly acid. Treated in succession with liquor potassæ and solutions of ferrous and of ferric sulphates, heated, and acidulated with HCl, it gives a green-coloured fluid, depositing Prussian blue. Treated with NH_4HS , and ferric chloride added after evaporation to dryness, it gives a deep blood-red colour. *Incompatibles.*—Salts of silver, copper, iron; red mercuric oxide and sulphides.

Acidum Hydrocyanicum (Scheele's) (*not official*) contains 4 per cent. of hydrogen cyanide.

DOSES.—Of the dilute acid (B.P.): Horses and cattle, ℥xx. to ʒi.; sheep, ℥x. to ℥xv.; pigs, ℥iv. to ℥vi.; dogs, ℥ii. to ℥v. The doses of Scheele's acid are one-half of the above.

ACTIONS.—Hydrocyanic acid is a general protoplasmic poison.

Externally, it is a local anæsthetic by depressing the peripheral endings of the sensory nerves. If applied over a large area of skin, it may be absorbed and produce toxic effects.

Internally, in medicinal doses, it acts as a sedative to the gastric nerves. It enters the blood rapidly, and profoundly affects metabolism, in that the tissues lose their power of absorbing oxygen from the blood. As the result of a fatal dose, the blood becomes of a bright red colour; this is due to the tissues being unable to reduce the oxyhæmoglobin.

TOXIC ACTIONS.—Hydrocyanic acid is one of the quickest and most fatal poisons.

In the dog, a dose of from 40 to 60 minims of Scheele's preparation may cause death very rapidly by paralysis of the cardiac and respiratory centres. Usually, however, death occurs from asphyxia.

The drug, being very diffusible and volatile, is quickly absorbed. Immediately after administration the animal makes a few quick inspirations, utters a suppressed cry, falls in convulsions, and death occurs in from two to three minutes from respiratory arrest; the heart continues to beat for several minutes after respiration has ceased. In other instances death does not occur so rapidly, and the symptoms observed are respiratory distress, dilatation of the pupils, impaired voluntary movement, weakness of the pulse, and tetanic convulsions.

Horses are not so susceptible to the official acid, and 3-drachm

doses have been administered by mouth without causing death. Doses of from 4 to 5 drachms of the official acid given by the mouth have caused death in about an hour.

The specific action of hydrocyanic acid is exerted on the central nervous system. The medullary centres are briefly excited; as a result, the respirations become quicker and deeper, the heart-beat is slowed, and blood-pressure rises. This phase of medullary stimulation is rapidly followed by depression and the nervo-muscular mechanism of the heart is directly depressed. The respirations become shallow, blood-pressure falls, and the heart-beat is slow and weak. The cerebrum and spinal cord are also rapidly depressed, and finally paralyzed, resulting in tonic and clonic convulsions, succeeded by coma and paralysis of the voluntary muscles.

The post-mortem appearances are not constant. When death has been instantaneous the blood throughout the body is of an arterial hue, and remains fluid for some hours. When death has occurred from paralysis of the respiratory centre, the usual appearances of asphyxia will be present. If the autopsy be held within a short time after death, the characteristic odour of the drug will emanate from the body.

ANTIDOTES.—The intravenous injection of sodium thiosulphate has proved effective; 40 to 50 c.c. of a 20 per cent. solution may be given to horses and cattle, and if necessary repeated in a few minutes. Artificial respiration constitutes an important means of treatment, but to be successful it must be carried out immediately after the poison has been taken. The subcutaneous injection of ether is also indicated. Other antidotes employed for the purpose of stimulating the cardiac and respiratory centres are the hypodermic injection of atropine, the inhalation of the vapour of ammonia, the inhalation of oxygen, and the use of the hot and cold douche alternately over the head and neck.

A ferric and ferrous salt, combined with magnesia or potassium carbonate, is recommended as a chemical antidote. Oxide of iron freshly precipitated with magnesia is also advised; but obviously, with such a rapidly acting poison, chemical antidotes prove of little or no avail.

USES.—*Externally*, the active poisonous properties of hydrocyanic acid and its volatility render it an inappropriate drug to use for external dressings.

Internally, as a gastric sedative, hydrocyanic acid is prescribed in gastritis in the dog. It lessens the irritability of the gastric nerves, arrests vomiting, and relieves pain. In such cases it may be prescribed with bismuth in an alkaline mixture. In obstinate vomiting, depending on any cause, hydrocyanic acid

often proves useful, but chloretone is more effectual. Hydrocyanic acid is occasionally prescribed to allay dry, irritable cough, but other drugs are preferable.

Hobday found that a full medicinal dose of hydrocyanic acid, placed on the tongue, acts as an antidote to respiratory collapse during chloroform anæsthesia in the dog. The action is believed to depend on the deep inspirations produced by the primary stimulation of the respiratory centre. Artificial respiration should be carried out at the same time.

Hydrocyanic acid is occasionally prescribed with other agents in the treatment of parasitic bronchitis in calves, and may be added to the solution for intratracheal injection in doses of 5 minims. It destroys the parasites by direct contact.

Hydrocyanic acid is contained in the Compound Tincture of Chloroform and Morphine (p. 231).

GROUP VIII—THE VEGETABLE KINGDOM.

Aconite.

Aconitum (Aconit.).—*Aconiti Radix*; Aconite Root. The dried root of *Aconitum napellus*, N.O. Ranunculaceæ.

Characters.—From 4 to 10 cm. long, 1 to 2 cm. wide at the upper extremity; conical, dark brown, with many root scars; crowned with base of stem or remains of bud. Internally, solid, starchy. Transverse section shows stellate cambium with small vascular bundles at projecting angles. No marked odour; taste at first slight, followed by sensation of tingling and numbness.

Composition.—The active constituent of aconite is an alkaloid, *aconitine*. *Benzaconine* (*picraconitine*), $C_{32}H_{45}NO_{10}$, *aconine*, $C_{25}H_{41}NO_9$, and other more or less allied alkaloids, occur along with it. They are combined with an acid, *aconitic acid*, $C_3H_3(COOH)_3$. Yields not less than 0.4 per cent. of ether-soluble alkaloids.

Tinctura Aconiti (*not official*).—Aconite Root with alcohol 70 per cent.; by percolation. *Standardized* to contain 0.04 g. ether-soluble alkaloids in 100 ml. *N.B.*—*This preparation is twice as strong as that of the B.P. 1898.*

Doses.—Horses, ℥x. to ʒss.; cattle, ʒi.; sheep and pigs, ℥v. to ℥x.; dogs, ℥i. to ℥v.

Linimentum Aconiti (Lin. Aconit.).—Aconite Root in alcohol 90 per cent. with camphor. *Standardized* to contain 0.2 g. ether-soluble alkaloids with 3 g. camphor in 100 ml.

Linimentum Aconiti Compositum.—A.B.C. Liniment (*not official*)—

Aconite liniment, belladonna liniment, chloroform liniment, equal parts.

Aconitina.—*Aconitine*, $C_{34}H_{45}NO_{11}$, an alkaloid obtained from Aconite Root (*not official*).

Characters.—Colourless, transparent, hexagonal crystals; rhombic, prismatic, and tabular. Melts at 198° C. with evolution of acetic acid. *Solubility*.—Almost insoluble in water, petroleum spirit, and carbon disulphide; readily in benzene and chloroform; less in ether and absolute alcohol. An aqueous solution (1 in 10,000) placed on the tongue causes tingling and numbness.

Dose.—For the horse, gr. $\frac{1}{10}$ to gr. $\frac{1}{5}$ by hypodermic injection.

Unguentum Aconitinæ (*not official*).—Aconitine, 2; Oleic Acid, 16, Prepared Lard, 82.

ACTIONS.—*Externally*, aconitine (and aconite), if applied to the skin or mucous membranes, first stimulates and subsequently paralyzes the peripheral endings of sensory nerves, and thus removes sensation from the part. It is not absorbed from the unbroken skin unless it be rubbed in with chloroform, alcohol, or some fatty substance, but is readily absorbed if applied to mucous surfaces. If injected hypodermically it causes a primary excitation of sensory nerve-endings, and thus induces pain.

Internally, aconite possesses anodyne, sedative, antipyretic, mild diaphoretic, and diuretic actions. It is rapidly absorbed, enters the tissues quickly from the blood, and causes a primary excitation, followed by secondary depression of the peripheral nerve-endings. It is principally excreted in the urine.

Small doses repeated at intervals lessen the frequency, force, and tension of the pulse, lower blood-pressure, and reduce febrile temperature.

The effects of aconite on the heart are believed to be mainly due to stimulation of the vagus centre. The fall in blood-pressure is almost wholly dependent upon the heart's action, the vaso-motor centre being practically unaffected.

The fall in temperature probably depends upon depression of the thermogenic centre and the depressed cardiac action.

The secretion of the skin and salivary glands is increased, and the flow of urine is slightly augmented; these effects are not understood.

The respiratory centre is at first stimulated, and later markedly depressed.

TOXIC ACTIONS.—The drug causes irritation of the stomach, evidenced in the dog by violent vomiting and continuous retching. The primary effect on the circulation results in slowing of the pulse, which, however, soon becomes frequent, irregular, and feeble, as the motor ganglia in the heart and the vagus centre become paralyzed.

On respiration, the toxic effect is that of depression; the respirations are at first slow and deep, but soon become shallow and laboured. The respiratory centre becomes paralyzed, and

death usually occurs from asphyxia; but a very large dose may kill by syncope, depending on sudden paralysis of the cardiac muscle. Convulsions may precede death, and probably depend upon asphyxia, as the cerebrum is unaffected.

On the nervous system, the chief toxic action of aconite is exerted on the medulla, which is first excited, then depressed, and finally paralyzed.

In the horse the toxic dose of tincture of aconite is variable. In one instance, 4 ounces given to a pony, although causing alarming symptoms, did not prove fatal; but it is to be remembered that preparations of aconite, unless physiologically standardized, are unreliable. The usual symptoms observed are salivation, champing of the jaws, frequent attempts at swallowing, a weak and very compressible pulse, regurgitation of gas and fluid from the nostrils, sweating, pallid mucous membranes, muscular twitching, and shallow, irregular breathing. In some instances evidences of irritation of the stomach and intestines are present, consisting of frequent attempts at vomiting, nausea, colicky pains, and diarrhoea, and in the later stages paralysis of the limbs occurs.

Cattle are much less susceptible to the action of the drug.

Dogs are very susceptible to aconite. The symptoms observed are violent vomiting, retching, salivation, muscular weakness, and paralysis of the posterior extremities. The toxic dose is variable.

The *post-mortem* appearances are those of asphyxia.

ANTIDOTES.—In the dog, if seen immediately after the drug has been taken, emetics should be at once administered. The most effectual is apomorphine, given hypodermically.

Stimulants, such as alcohol and ammonia, are indicated; but as there is usually difficulty in swallowing, the hypodermic injection of ether is preferable.

Atropine is recommended; by hypodermic injection—for the dog $\frac{1}{16}$ grain, and for the horse $\frac{1}{2}$ grain; the dose is to be repeated in fifteen minutes if the pulse does not improve.

Digitalis and inhalations of amyl nitrite are also antidotes. The body should be kept warm, and, if necessary, artificial respiration practised.

MEDICINAL USES—*Externally*, aconite as a liniment or ointment is occasionally applied as a local anodyne.

The danger of absorption should be remembered, and aconite in any form should not be used as an external application for the dog.

Internally, aconite is now seldom employed. As it is a powerful depressing agent, its use is contraindicated in respiratory affections, and other drugs are safer and more effectual as febrile-

fuges. It is chiefly used in veterinary practice in the treatment of laminitis, in which it relieves pain and reduces the force and frequency of the pulse. It should be administered at first in a full dose, and afterwards repeated every two hours in half-doses. It is readily taken in the drinking water.

Aconite is sometimes prescribed in painful abdominal disorders in the horse, but other anodyne agents are preferred.

Veratrine.

Veratrina—Veratrine (*not official*).

An alkaloid or mixture of alkaloids obtained from Cevadilla or Sabadilla, the dried ripe seeds of *Schænocaulon officinale*—a Mexican plant.

Doses.—Horses, gr. i. to grs. iii. given *per os*, gr. ss. to gr. i. by hypodermic injection; cattle, grs. ii. to grs. v. *per os*, gr. i. to grs. iii. by hypodermic injection.

ACTIONS.—The actions of veratrine in some respects resemble those of aconite.

Externally, it is an irritant to the skin and mucous surfaces; in its secondary action it depresses the terminations of sensory nerves, and causes loss of sensibility in the parts to which it is applied.

Internally, veratrine is a powerful topical irritant. It has no marked action on the brain or spinal cord, but it first excites and ultimately paralyzes the endings of both motor and sensory nerves. It has a special action on voluntary muscle, increasing its contractile power, and producing a well-marked lengthening of contraction. It also stimulates contraction of the muscular coats of the stomach and intestines, and thus increases peristaltic action. It markedly lengthens cardiac contraction and reduces the frequency of the pulse. Its action on the vagus is similar to that on spinal nerves, the primary excitation being partly responsible for the slowing of the heart; the secondary depressant action on the vagus does not, however, result in cardiac acceleration, because of the effect of the drug upon cardiac contraction. Large doses lower blood-pressure, and cause a slow, feeble, and irregular pulse. Respiration is at first accelerated, but toxic doses cause the respirations to become slow and finally paralyze the respiratory centre, death occurring from asphyxia.

Toxic doses in the horse cause salivation, purging, attempts at vomiting, shallow respiration, muscular twitching, and violent contraction of the abdominal muscles.

In the dog, emesis occurs, and paralysis of the extremities, preceded by convulsions, may be present in the later stages.

MEDICINAL USES.—Veratrine is seldom prescribed by British practitioners. Continental authorities employ it in the treatment of gastric impaction in cattle, a dose of from 2 to 3 grains being injected hypodermically. In this condition it is also employed in doses of $\frac{5}{8}$ grain administered by subcutaneous injection, and repeated every two hours until the desired effect is produced. The drug may also be combined with strychnine and physostigmine.

Veratrine is employed in the treatment of chronic cough and 'broken wind,' in combination with strychnine and ergot.

Veratrine, in combination with physostigmine and pilocarpine, is suggested in the treatment of impaction of the colon in the horse, but in consequence of its violent action, when injected hypodermically, it cannot be regarded as a safe agent in equine practice. The drug should not be prescribed in canine practice.

Stavesacre.

Staphisagriæ Semina.—Stavesacre Seeds (*not official*). The dried ripe seeds of *Delphinium staphisagria*, N.O. Ranunculaceæ.

Characters.—Irregularly triangular or obscurely quadrangular, arched, blackish-brown when fresh, dull greyish-brown by keeping. Surface wrinkled and deeply pitted; kernel soft, whitish, oily. No marked odour; taste nauseous, bitter, acrid.

Composition.—Contains four alkaloids: *delphinine*, allied to aconitine; *staphisagrine*, *delphtnoidine*, and *delphisine*.

Unguentum Staphisagriæ (*not official*).—Stavesacre Seeds, 20; Yellow Beeswax, 10; Benzoated Lard, 85.

ACTIONS AND USES.—Strong solutions of stavesacre, if applied too freely to the denuded skin of the dog, or if licked by the animal, become absorbed, and may produce toxic symptoms, evidenced by nausea, cardiac weakness, and prostration.

Delphinine in many respects resembles aconitine in its actions, and is even more powerful as a circulatory depressant.

Stavesacre is chiefly used in veterinary practice as a parasiticide. A decoction prepared by boiling 1 part of the bruised seeds in 20 to 30 parts of water for two hours is employed for the destruction of lice, and should be rubbed into the skin; it destroys both the pediculi and their eggs. This preparation should be used with caution in canine practice.

Derris.

Derris or Tuba (*not official*). The dried root of *Derris elliptica* and other plants belonging to the genus *Derris*.

Composition.—Derris contains 10 to 30 per cent. of material soluble in ether, benzene, chloroform, etc., obtainable as a hard,

brittle, pale yellow or brown resin and known as Derris Extract or Derris Resin; good commercial root contains 15 to 25 per cent. of this extract. The root contains also starch and saponaceous matter. The extract contains widely varying amounts of *rotenone* (2 to 40 per cent.), $C_{23}H_{22}O_6$, colourless crystals, m.p. 163° C., and *l-toxicarol* (0 to 50 per cent.), $C_{23}H_{22}O_7$, yellow crystals, dimorphic, m.p. 102° and 126° to 127° , with smaller, varying amounts of *sumatrol*, $C_{23}H_{22}O_7$, colourless crystals, m.p. 195° to 196° , *l-elliptone*, $C_{20}H_{16}O_6$, colourless crystals, m.p. 159° , *malaccol*, $C_{20}H_{16}O_7$, yellow crystals, m.p. 225° , other phenols and waxes; *l-deguelin* is probably also present in considerable amount.

The insecticidal properties are due mainly to the rotenone and *l-deguelin*, the other ingredients making smaller but not negligible contributions.

ACTIONS AND USES.—Derris is a powerful insecticide, and is of marked value in the treatment of pediculosis in all animals.

The powdered root can be worked up in water together with soap or other emulsifying agents. As derris is a contact parasiticide, and since the active principles are solids and only slightly soluble in water, their activity would appear to depend upon their degree of dispersion.

Derris Extract is largely employed in the destruction of warble-fly larvæ (*Hypoderma bovis*) in cattle. For this purpose powdered derris 1 pound, soft soap $\frac{1}{4}$ pound in water 1 gallon, is a suitable preparation. The soft soap is dissolved in about 1 quart of boiling water and allowed to cool to about 100° F. The powdered derris is thoroughly mixed with the soap solution and then cold water is gradually added to make up to 1 gallon. The mixture should be freshly prepared and should be stirred regularly to keep the derris in suspension. Dressings should be applied to affected animals four times during the period from the end of March to the third week in June.

Similar dressings are effective against fleas, keds (*Malophagus ovinus*), and certain species of ticks—e.g., *Ixodes ricinus*.

The active principles are unstable in the presence of alkaline solutions, and dipping baths or washes gradually lose their efficacy if kept for a number of days after preparation.

Opium.

Opium (Opium).—Opium. The juice obtained by incision from the unripe capsules of *Papaver somniferum*, N.O. Papaveraceæ, the white poppy, inspissated by spontaneous evaporation.

Characters.—Rounded, irregular, or flattened masses, weighing from 250 to 1,000 g. When fresh, plastic; internally moist, coarsely granular or nearly smooth and reddish- or chestnut-brown; but becoming harder on keeping, and darkening to blackish-brown. Odour strong, characteristic; taste bitter.

Composition.—Opium contains: (1) certain *alkaloids*; (2) a *neutral substance*; (3) two organic acids; (4) about 16 per cent. of *water*; (5) resin, gum, salts, extractives, odorous principles, and other constituents of plants. The most important alkaloids of opium are: morphine, not less than 9·5 per cent.; codeine, 0·3 to 1·9 per cent.; narcotine, 2 to 8 per cent.; thebaine, up to 0·3 per cent. *Incompatibles.*—Alkaline carbonates, lime-water, salts of lead, iron, copper, mercury, and zinc, and vegetable astringents.

Opium Pulveratum (Opium Pulverat.).—Powdered Opium. Adjusted to contain 10 per cent. morphine.

DOSES OF POWDERED OPIUM.—Horses, \mathfrak{z} i. to \mathfrak{z} ii.; cattle, \mathfrak{z} ii. to \mathfrak{z} iii.; sheep, grs. x. to grs. xxx.; dogs, grs. ss. to grs. ii. These doses must be modified according to the size of the animals and to circumstances.

PREPARATIONS OF OPIUM EMPLOYED IN VETERINARY PRACTICE.

Extractum Opii Siccum (Ext. Opii Sicc.).—Aqueous. *Standardized* to contain 20 per cent. of morphine.

DOSES.—Dog, gr. $\frac{1}{4}$ to gr. i.

Extractum Opii Liquidum (not official).—Dry Extract of Opium, 3·75; Alcohol 90 per cent., 20; Water to 100; by maceration. *Standardized* to contain 0·75 g. of morphine in 100 ml., or $\frac{1}{4}$ gr. in 110 min.

DOSES.—Dog, \mathfrak{M} v. to \mathfrak{M} xx.

Pulvis Ipecacuanhæ et Opii (Pulv. Ipecac. et Opii).—Dover's Powder. Opium, Ipecacuanha, Lactose. Contains 10 per cent. opium. (See p. 325.)

Tinctura Opii (Tinct. Opii).—Laudanum; Opium, with Alcohol 90 per cent. and Distilled Water, of each a sufficiency to produce a *standardized tincture* containing 1 g. of morphine in 100 ml., or 1 gr. in 110 min.

DOSES.—Horses and cattle, \mathfrak{z} ss. to \mathfrak{z} ii.; sheep and pigs, \mathfrak{z} ss. to \mathfrak{z} ii.; dogs, \mathfrak{M} v. to \mathfrak{M} xx. These doses should be modified according to requirements.

Tinctura Opii Camphorata (Tinct. Opii Camph.).—Paregoric; Compound Tincture of Camphor, Paregoric Elixir, Tincture of Opium, Benzoic Acid, Camphor, Oil of Anise, Alcohol 60 per cent. Contains 0·05 per cent. morphine, or 0·5 mg. in 1 ml. ($\frac{1}{37}$ gr. in 1 fl. dr.). (See p. 282.)

The official salts of morphine are the hydrochloride and the tartrate.

Morphinæ Hydrochloridum (Morph. Hydrochlor.).—Morphine Hydrochloride; $\text{C}_{17}\text{H}_{19}\text{NO}_3 \cdot \text{HCl} \cdot 3\text{H}_2\text{O}$. The hydrochloride of an alkaloid, morphine, obtained from opium.

Characters.—Acicular crystals, or a white microcrystalline powder; taste bitter. **Solubility.**—1 in 25 of water; 1 in 50 of alcohol.

DOSES.—By hypodermic injection: Horses, grs. ii. to grs. iv.; cattle, grs. iv.; sheep and pigs, gr. ss. to gr. i.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$.

Morphinæ acetat and morphinæ tartras are prescribed in similar doses to the hydrochloride.

Liquor Morphinæ Hydrochloridi (Liq. Morph. Hydrochlor.).—Solution of Morphine Hydrochloride. Morphine Hydrochloride; Diluted Hydrochloric Acid; Alcohol 90 per cent.; Water. Contains 1 per cent. morphine hydrochloride (1 gr. in 110 min.).

Doses.—Horses and cattle, ʒss. to ʒii.; sheep and pigs, ʒss. to ʒii.; dogs, ℥v. to ℥xx.

Tinctura Chloroformi et Morphinæ Composita (*not official*).—Made by dissolving Morphine Hydrochloride, 1, in a mixture of Oil of Peppermint, 0.2; Chloroform, 7.5; Tincture of Capsicum, 2.5; Tincture of Indian Hemp, 10; Glycerin, 25; and Alcohol 90 per cent., 45; adding Diluted Hydrocyanic Acid, 5; and Alcohol to 100. 10 min. contain $\frac{1}{2}$ min. of Chloroform, $\frac{1}{11}$ gr. of Morphine Hydrochloride, and $\frac{1}{2}$ min. of Diluted Hydrocyanic Acid.

This is an imitation of the proprietary preparation known as Chlorodyne.

Doses.—Horses and cattle, ʒi. to ʒii.; dogs, ℥v. to ℥xv.

Various formulæ are employed in the preparation of chlorodyne for veterinary purposes. The amount of morphine present is usually 4 grains to the fluid ounce.

Morphinæ Tartras (Morph. Tart.).—Morphine Tartrate; $(C_{17}H_{19}NO_3)_2C_4H_6O_6, 3H_2O$.

Characters.—Minute acicular crystals, efflorescent at 20° C.; taste bitter. **Solubility.**—1 in 11 of water; solution neutral.

Note.—In purchasing, prescribing, and dispensing opium and morphine and their preparations, the requirements of the *Dangerous Drugs Acts and Orders* must be observed (see p. 508).

ACTIONS OF OPIUM.

Externally.—It was formerly believed that opium applied locally lessened the sensibility of sensory nerves, but it has no action on either sensory or motor nerve-endings.

Internally—The Alimentary Tract.—Opium in large doses is an antisialogogue. It is believed that this effect is due to a central action. In the horse and dog, severe nausea may follow the oral administration of the drug or the hypodermic injection of morphine; actual vomiting may occur in the dog, and this effect is due to stimulation of the vomiting centre. Opium is a powerful sedative to the gastro-intestinal tract, acting by markedly depressing the local autonomic nervous mechanism. Gastro-intestinal secretion is also to some extent diminished in the normal animal, but the free intestinal secretion associated with severe irritation of the bowel is markedly inhibited by opium. The pyloric and ileo-cæcal sphincters are constricted, and

as a result of these several effects, ingesta pass slowly along the tract; relatively large quantities of fluid are absorbed from the bowel, and a marked constipating effect is induced. Large doses produce a paralyzed condition of the intestines.

The Nervous System.—The actions of morphine differ considerably in man and in the lower mammals. In man, the sensory areas of the cerebrum, which are developed to a much greater degree than in animals, are first briefly stimulated and then depressed by morphine, so that the drug induces sleep, which may be preceded by a brief period of excitement.

In the lower mammals, the motor centres in the brain and cord are stimulated, and their reflex excitability increased by morphine. In the horse, the higher faculties of perception are very much less developed as compared with those of man, but there is relatively greater development of the locomotor centres and of the reflex centres of the spinal cord. The sedative and hypnotic effects of opium are not usually so well marked in the horse as in man, and if full or repeated doses be given, there are produced symptoms of excitement evidenced by restlessness, followed after an indefinite period by drowsiness, locomotor disturbance, and convulsions. These effects, as has been indicated, appear to depend upon stimulation of the motor centres of the brain and cord, and upon increase of their reflex excitability. As an intestinal sedative, opium may relieve the griping pains of spasmodic colic, but in violent and continued pain, such as is associated with acute intestinal impaction, moderate doses produce no anodyne action, and if large doses be given, convulsive symptoms are induced. On the medullary centres morphine has a curious selective action, in that, while it depresses the respiratory and cough centres, it stimulates the vagal and the vomiting centres.

In ruminants, full doses also produce excitement, and it is only after large amounts have been administered that the hypnotic effects of the drug become manifest. Digestive derangement with tympanites is also frequently evident.

In the dog, moderate doses exert a primary excitant effect; this is followed by sleep, but the hypnotic action of the drug is not so well marked as in man, and the sleep induced is accompanied by muscular twitchings, and is not profound.

In the cat, full doses of morphine usually induce marked restlessness, excitement, and even convulsions.

The remarkable variation which individual species of animals exhibit in their nervous response to morphine is not completely explained by the relative development of the sensory cerebral centres as compared with the motor centres of the brain and cord.

According to Cushny, there is evidence that, while morphine itself is depressant, the product formed by its oxidation in the body is stimulant, and differences in the rate of oxidation in the different animals determine whether the primary or secondary effect predominates.

The Heart and Circulation.—Morphine possesses little effect on the heart or vessels. Because of a slight depressant action on the vasomotor centre, it causes dilatation of the cutaneous bloodvessels, but has little action on other vessels, and so has practically no influence on blood-pressure.

Respiration.—Morphine depresses the respiratory centre, but the cerebral sensory centres are depressed much earlier than the respiratory centre, which is only seriously affected after large doses. The result of this depression is that reflex respiratory acts, such as coughing, are less liable to occur (the centre which controls the reflex act of coughing lies in close apposition to the respiratory centre).

Toxic doses arrest respiration by paralysis of the respiratory centre.

The bronchial secretions are somewhat diminished.

The Skin.—Moderate doses in the horse do not produce any appreciable effect on the cutaneous secretion, but large or repeated amounts may cause sweating, possibly due to dilatation of the cutaneous bloodvessels. Toxic doses may produce profuse sweating towards the later stages, this probably depending on stimulation of the sweat centres in the spinal cord.

In the dog, a dry, congested condition of the skin is observed.

The Kidneys.—Morphine has no influence on the secretion of urine. It may, however, interfere with the micturition reflex by depressing reception and conductivity, so that, although the bladder may be distended, no attempts at urination may be made by the animal.

The Eye.—In the horse, the pupil is generally dilated by morphine.

In the dog, the pupil is contracted while the animal is under the narcotic influence of the drug. The effect is due to stimulation of the oculomotor centre, for, although the myosis is overcome by the local application of atropine, when morphine is applied to the cornea the pupil remains unaffected.

Temperature.—Opium in medicinal doses has practically no effect upon the body temperature; excessive doses may cause the temperature to fall.

Metabolism.—General metabolism is decreased. Morphine brings about a diminution in blood glucose, probably by interference with the glycogenolytic function of the liver.

Excretion.—Opium is excreted by the bowel, and only a trace can be detected in the urine. Excretion commences rapidly, but after full doses have been administered it may not be completed for several days. Morphine can be detected in the stomach even when it has been administered by hypodermic injection.

TOXIC ACTIONS.—Death in morphine-poisoning results from depression of the respiratory centre, but it has been found that large doses of opium or morphine can be tolerated by the horse without causing death. The lethal dose of morphine for the horse is said to be from 40 to 75 grains administered hypodermically, and of opium from 2 to 2½ ounces given by the mouth. Individuals possess very marked variation in their susceptibility to the toxic actions of morphine.

Ruminants are generally not so susceptible as horses to the toxic effects of morphine.

In the dog, toxic doses of opium or morphine cause vomiting, delirium, clonic spasms, and stertorous breathing. In small dogs of 12 to 16 pounds weight, 2 to 3 grains of morphine injected hypodermically have proved fatal.

The *post-mortem* appearances are those of asphyxia.

ANTIDOTES.—Poisoning by opium is very rare in animals. The excitement which occurs in the horse after full or repeated doses usually passes off without the necessity for treatment. Potassium permanganate oxidizes morphine, and when administered in an acidulated solution, the action of the antidote is enhanced.

In the dog, emetics should first be given, and irrigation by means of the stomach tube may be attempted. Measures should be adopted to rouse the animal, and the alternate application of hot and cold douches to the head and neck is useful. Artificial respiration should be resorted to, and the surface of the body kept warm. The hypodermic injection of small doses of atropine as a stimulant to the respiratory centre may be employed (large doses of atropine depress the respiratory centre), but caffeine hypodermically is preferable. Enemata of strong coffee may also be given.

It is generally believed that opium is more effective than morphine as an intestinal sedative, but for other purposes morphine is preferred to opium.

FACTORS MODIFYING THE ACTION OF OPIUM AND MORPHINE.

(a) *Youth.*—Young animals are more susceptible to the action of opium than are adults.

(b) *Pain.*—In disease characterized by severe pain, much

larger doses of opium are tolerated without their producing toxic effects.

(c) *Combinations with Other Drugs.*—Morphine is often prescribed in combination with small doses of atropine. The combination prevents certain of the undesirable effects of morphine, such as respiratory depression, nausea, and constipation. Chloral hydrate combined with morphine potentiates its narcotic action.

In some respects the actions of atropine are antagonistic to those of morphine. Thus atropine stimulates the respiratory centre and morphine depresses it. Atropine acts as an anhidrotic by influencing the nerve terminals in the sweat-glands. Morphine produces diaphoretic effects by causing cutaneous vaso-dilatation. Atropine in large doses stimulates the local autonomic nervous mechanism of the bowel, and thus tends to increase peristaltic action. Morphine lessens peristaltic action, and induces constipation.

MEDICINAL USES OF OPIUM AND MORPHINE.

Externally, opium in the form of liniment was at one time largely used as a local anodyne to bruises, contusions, and superficial inflammations, but as it possesses no local action it is no longer employed for this purpose.

Internally, although opium has been employed from early times in the treatment of abdominal pain in the horse, it is now recognized that it was frequently prescribed irrationally.

If the pain depends on the presence of irritating ingesta in the intestines, or on acute impaction of the double colon, it is apparent that opiates are contra-indicated, as they interfere with peristaltic action. In such conditions the administration of chloral hydrate combined with a purgative is rational treatment.

In hopeless conditions, such as acute enteritis and volvulus, the practitioner can only endeavour to relieve the pain by administering anodynes; opium, because of the excitement and delirium which full doses produce, is of no value for this purpose.

In the treatment of diarrhoea and dysentery, opium is a valuable agent, and may be combined with astringents such as chalk, catechu, etc. The compound tincture of chloroform and morphine (chlorodyne) is a valuable preparation in these conditions.

In eversion of the uterus, bladder, rectum, or vagina, the use of opium is indicated. It prevents the patient from straining, and thus reduces the liability of recurrence of eversion after replacement.

Morphine is sometimes given to horses prior to the administration of chloroform; in some instances it shortens the period of excitement, but in others it has the opposite effect. A combination of morphine with hyoscine hydrobromide is largely used for this purpose, and is also employed as a sedative for the purpose of rendering vicious horses docile while being shod or clipped, but chloral hydrate is to be preferred.

In canine practice opium proves an efficient anodyne; but the doses must be carefully regulated, otherwise vomiting and extreme nausea result.

In abdominal pain in the dog, care is necessary in prescribing opiates, as they mask the symptoms, and thus may lead the practitioner to overlook the necessity for performing laparotomy, which, if its practice be indicated, must be performed before the vitality of the animal becomes exhausted.

Morphine administered by hypodermic injection is sometimes employed to produce a condition of narcosis in the dog, during which even major operations may be performed. For this purpose, from gr. $\frac{1}{16}$ to gr. i., according to the size of the patient, is administered by hypodermic injection. It is also advised in doses of gr. $\frac{1}{32}$ to gr. $\frac{1}{16}$, injected about thirty to forty minutes prior to the administration of a general anæsthetic. It can with advantage be combined with atropine or hyoscine.

Morphine is an antidote to strychnine-poisoning in the dog. The drug should be pushed until the spasms are overcome; large doses can be tolerated, and 5 grains have been given with success to a collie suffering from strychnine-poisoning. It should be given hypodermically in conjunction with the rectal injection of chloral hydrate.

Repeated hypodermic injections of morphine are said to control the spasms of tetanus.

CONTRA-INDICATIONS OF OPIUM AND MORPHINE.

(a) In cerebral congestion and in cerebral meningitis opiates should be avoided, as they increase the tendency to coma. In meningitis they have no effect in medicinal doses, and in full amounts they increase the excitement of the patient.

(b) In diseases of the respiratory organs, with shallow, distressed breathing, opiates, by their depressing effect on the respiratory centre, are contra-indicated. They should also be avoided in bronchitis.

(c) In abdominal pain in the horse, opiates should not be employed (see p. 234).

Apomorphinæ Hydrochloridum (Apomorph. Hydrochlor.).—Apomorphine Hydrochloride; $(C_{17}H_{17}NO_2 \cdot HCl)_2 \cdot H_2O$. The hydrochloride

of an alkaloid obtained from morphine by the abstraction of the elements of a molecule of water. $C_{17}H_{19}NO_3 = C_{17}H_{17}NO_2 + H_2O$.

Characters.—Small, greyish-white, shining needles, turning green on exposure to light and air; inodorous, very faintly acid. *Solubility*.—1 in 60 of water; 1 in 50 of alcohol 90 per cent. Solutions become decomposed and green when boiled or kept; give with $NaHCO_3$ a white precipitate which becomes green on standing, and then forms a purple solution with ether, bluish with chloroform, and green with alcohol 90 per cent. With dilute test solution of ferric chloride it gives a deep-red coloration.

Dose.—As emetic (by hypodermic injection): For the dog, gr. $\frac{1}{30}$ to gr. $\frac{1}{10}$; by the mouth, gr. $\frac{1}{30}$ to gr. $\frac{1}{5}$.

As expectorant (by hypodermic injection): gr. $\frac{1}{30}$ to gr. $\frac{1}{10}$.

ACTIONS AND USES.—Apomorphine acts promptly as a central emetic in carnivora. Toxic doses in the dog stimulate the motor centres of the central nervous system, causing in some instances 'circus movements,' the animal walking unceasingly in a circle; the respirations are accelerated, tetanic convulsions occur, and death results from asphyxia.

In the horse doses of 2 grains cause delirium, sweating, and marked respiratory distress.

Apomorphine is chiefly used as an emetic for the dog in cases of poisoning. It exerts its emetic effect by stimulating the vomiting centre in the medulla, and, administered by hypodermic injection, it usually acts in from two to three minutes, producing little nausea or depression.

In cases of narcotic poisoning, however, because of the medullary depression, apomorphine may fail to act. It is especially useful when there is inability to swallow.

Codeina (Codein).—Codeine; $C_{17}H_{19}(CH_3)NO_3 \cdot H_2O$. An alkaloid obtained from opium or morphine.

Characters.—Nearly colourless crystals; taste bitter; aqueous solutions alkaline. *Solubility*.—1 in 80 of water or of solution of ammonia; readily in alcohol 90 per cent., in chloroform, and in diluted acids. *Tests*.—With HNO_3 gives yellow, not red (distinction from morphine); a saturated aqueous solution acid with HCl gives dull green but no blue colour with Fe_2Cl_6 and dilute potassium ferricyanide solution (absence of morphine); a solution in H_2SO_4 with ammonium molybdate or Fe_2Cl_6 gives deep bluish-violet colour changing to scarlet and orange with HNO_3 .

Codeinæ Phosphas (Codein. Phosphas).—Codeine Phosphate, the phosphate of the alkaloid codeine.

Characters.—Colourless acicular crystals or crystalline powder; odourless; taste bitter. *Solubility*.—1 in 3.5 parts of water.

Dose.—Dogs, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$.

Syrupus Codeinæ Phosphatis (not official).—Codeine Phosphate, 0.5; Water, 1.5; Syrup to 100. Contains 0.5 per cent. codeine phosphate (0.27 gr. in 1 fl. dr.).

Dose.—Dogs, ℥xx. to ʒi.

ACTIONS.—While codeine has only about one-twentieth the narcotic effect of morphine, it possesses about one-third the power of morphine in depressing the respiratory and cough centres; it is therefore preferred to morphine as a cough sedative. In large doses codeine may act as an excitant and convulsant in small animals. Its effect upon sugar metabolism is similar to that of morphine, but this action has no application in therapeutics. Codeine is entirely excreted in the urine.

USES.—Because of its depressant action on the cough centre, codeine is used to overcome the useless irritating cough associated with some cases of bronchial catarrh in the dog. It is to be remembered, however, that cough is commonly a salutary effort representing the natural response to the presence of excessive mucus in the bronchi, and in such cases an expectorant and not a cough sedative is indicated.

NARCOTINE AND PAPAVERINE have a mild narcotic action, but are not employed in veterinary practice.

THEBAINE resembles strychnine in its actions; it stimulates the motor tracts of the spinal cord and produces convulsions. It is of no therapeutical interest.

Diamorphinæ Hydrochloridum (Diamorph. Hydrochlor.).—Diamorphine Hydrochloride; $C_{21}H_{23}NO_5 \cdot HCl \cdot H_2O$; Diacetylmorphine Hydrochloride; 'Heroin.'

Source.—The hydrochloride of an alkaloid obtained by the action of acetic anhydride on morphine.

Characters.—White crystalline powder; taste bitter. **Solubility.**—1 in 3 of water; 1 in 11 of alcohol 90 per cent. **Impurity.**—Morphine.

DOSES.—Horses, gr. ss. to gr. i. *per os*, repeated every four hours; dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$, every three hours.

The terms of the Dangerous Drugs Acts and Orders apply to Diamorphine Hydrochloride.

ACTIONS AND USES.—Heroin in its general actions resembles morphine; it acts more powerfully as a respiratory depressant and less powerfully as a narcotic, but is not less dangerous than morphine. Heroin, like codeine, is principally employed in the treatment of irritable coughs.

It may be conveniently administered in combination with glycerin, and various preparations of heroin and glycerin are in use. They usually contain $\frac{1}{18}$ grain of heroin hydrochloride in each fluid drachm, combined with other expectorants.

Papaveretum (B.P.C.), Omnopon, Pantopon.—A mixture of the soluble hydrochlorides of opium alkaloids; is a brown powder containing about 50 per cent. morphine.

Omnopon is said to be more powerful than morphine as a narcotic, probably in virtue of its containing narcotine, which, although in itself possessing little narcotic power, is a powerful

synergist to morphine in this respect. It is less depressant to the respiratory centre than morphine, and is less active in depressing peristalsis.

It is used as a narcotic prior to the induction of chloroform anæsthesia in the dog.

DOSE.—gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$ hypodermically.

Cannabis Indica.

Cannabis Indica.—Indian Hemp; Ganji or Gunjah (*not official*). The dried flowering or fruiting tops of the pistillate plant, *Cannabis sativa*, N.O. Urticaceæ (grown in India), from which the resin has not been removed.

Characters.—Compressed, rough, dusky-green masses, consisting of the branched upper part of the stem, bearing leaves and pistillate flowers or fruits matted together by a resinous secretion. Odour strong, characteristic; taste slight.

Composition.—*Cannabis indica* has yielded an amorphous resin, *cannabinone*, which contains a phenol-aldehyde, *cannabinol*, $C_{21}H_{30}O_2$; alkaloids, *choline* and perhaps *cannabinine*; and a volatile oil, *cannabinene*. **Incompatibles.**—Water, and watery infusions, which precipitate the resin.

Extractum Cannabis Indicæ (*not official*).—Alcoholic 90 per cent.; by percolation and evaporation to soft extract.

DOSES.—Horses, $\frac{3}{4}$ ss. to $\frac{3}{4}$ i.; dogs, gr. $\frac{1}{4}$ to grs. iii.

Tinctura Cannabis Indicæ (*not official*).—Extract, 5; Alcohol 90 per cent. to 100.

DOSE.—For the dog, \mathbb{M} v. to $\frac{3}{4}$ i.

(The estimation of the dose is frequently a matter of difficulty, as there appears to be a great variation in individual susceptibility to the actions of the drug.)

The tincture is not convenient for the horse, in consequence of the large dose that is necessary. As the addition of water precipitates the resin, the drug must be triturated in mucilage before diluting it for administration.

For the horse the extract of *cannabis indica* is the preparation employed; it is preferably given in emulsion, but may also be administered as a bolus. Samples of *cannabis indica* are found to vary very much in their activity, and some are almost inert.

A fluid extract which is standardized physiologically can be obtained.

The terms of the Dangerous Drugs Acts and Orders apply to Indian Hemp and its preparations.

ACTIONS.—*Cannabis indica* exerts anodyne and hypnotic actions. The effect of the drug is usually seen within half an hour of administration. The delirium which is occasionally induced in man is not observed in animals, although a primary stage of exaltation, restlessness, and occasional vomiting may be observed in the dog. No primary excitant action occurs in

the horse; the animal assumes a sleepy appearance, the head is shaken in a listless manner, the eyelids droop, there is disinclination to move; the animal appears unconscious of environmental influences, but the standing posture is maintained. These effects gradually pass off in from ten to twelve hours; constipation does not occur to the same extent as after the administration of opiates, nor is nausea so marked. Larger doses, such as an ounce of the extract, cause in some horses an alarming condition of narcosis. The lips are retracted, the eyelids closed, the tongue hangs from the mouth, the respirations are accelerated and may be stertorous, there is partial loss of control over the hind extremities; the pulse becomes weak, salivation is profuse, and the penis may be pendulous; common sensibility is also interfered with, and there may even be no response to skin puncture. This state of narcosis may continue from twenty-four to thirty hours, and then gradually passes off; the degree of resulting nausea is slight, and the peristaltic action of the bowels is only occasionally interfered with when constipation may occur. The number of fatalities resulting from toxic doses of *cannabis indica* in the horse is very small; large doses, while producing profound narcosis, only very occasionally cause death.

Large doses slow the pulse partly because of vagal stimulation and partly through direct depression of the cardiac muscle.

In the dog, the extract of *cannabis indica* in doses of 10 grains to 2 drachms produces stupor and paralysis of the hind-limbs; this condition may last for two days before terminating in recovery.

Cushny states that *cannabis indica* produces polyuria in dogs, in which animals cannabinol appears to be excreted in the urine in combination with glycuronic acid (see p. 37).

MEDICINAL USES.—*Cannabis indica* has proved valuable as an anodyne in acutely painful conditions such as volvulus and enteritis. Some practitioners prefer chloral hydrate as an anodyne in intestinal impaction, since *cannabis indica* is said occasionally to inhibit peristalsis.

Cannabis indica is used as a general anæsthetic. For this purpose, Winslow advises 10 to 15 c.c. of a standardized fluid extract as an intravenous injection for the horse. It is remarkable that no case of embolism following this mode of administration has been recorded. But its use as an anæsthetic possesses the serious disadvantage that the horse may remain in a condition of deep stupor for several hours after the operation has been completed.

Cannabis indica has been found of value in controlling the severe spasms of tetanus.

LOCAL ANÆSTHETICS.

Cocaina (Cocain.).—Cocaine; $C_{17}H_{21}NO_4$. An alkaloid obtained from the leaves of *Erythroxylum coca* and its varieties; N.O. Erythroxylaceæ.

Characters.—Colourless monoclinic prisms; no odour; taste bitter, followed by a sensation of tingling and numbness. M.p. 98° C. **Solubility.**—Almost insoluble in water; 1 in 10 of alcohol 90 per cent.; 1 in 4 of ether; 2 in 1 of chloroform; 1 in 24 of olive-oil. **Impurities.**—Chlorides, sulphates.

Cocainæ Hydrochloridum (Cocain. Hydrochlor.).—Cocaine Hydrochloride; $C_{17}H_{21}NO_4 \cdot HCl$. The hydrochloride of cocaine.

Characters.—Colourless prismatic crystals or a crystalline powder. No odour; taste bitter, followed by tingling and numbness. M.p. 182° to 186° C. **Solubility.**—2 in 1 of cold water, 1 in 3 of alcohol 90 per cent.; insoluble in olive-oil. Aqueous solution neutral; applied to the eye dilates the pupil. The salt with HNO_3 evaporated to dryness gives, on adding alcoholic KOH solution, odour like peppermint. Solution with N/10 $KMnO_4$ and dilute H_2SO_4 gives violet colour, not fading in half an hour (absence of impurities). **Impurities.**—Cinnamyl cocaine and cocaine.

INCOMPATIBLES.—Alkalies and alkaline carbonates, borax, carbolic acid, mercurous and mercuric chlorides, and soluble silver salts.

Oculentum Cocainæ (Oculent. Cocain.).—Cocaine Eye Ointment contains 0.25 per cent. of cocaine hydrochloride.

The terms of the Dangerous Drugs Acts and Orders apply to Cocaine.

ACTIONS—Externally.—Cocaine, if applied in solution to mucous surfaces, or injected hypodermically, is a local anæsthetic by paralyzing the sensory nerve terminals. It has no effect if applied to the intact skin, unless combined with an agent which readily penetrates the skin, and applied with friction. A 2 per cent. solution applied to the eye anæsthetizes the superficial structures, partially paralyzes accommodation, and dilates the pupil. It was believed that the mydriasis was due to local stimulation of the sympathetic nerve terminals, but cocaine is not known to stimulate any of the other terminals of the sympathetic. On the other hand, it depresses the tone of all forms of plain muscle, and the dilatation is more probably due to direct depression of the circular muscle of the iris. The dilatation is more pronounced in the dog than in the horse, and is much more readily abolished by pilocarpine than is that produced by atropine. The cocainized pupil continues to exhibit the light reflex; it contracts upon exposure to bright light and dilates still further in the dark.

The local anæsthetic action commences in about five minutes, and may continue for thirty minutes. Ten per cent. solutions applied to a mucous membrane blanch and anæsthetize the part, the former action being due to constriction of the local capillaries.

The local vaso-constriction is possibly due to direct stimulation of the vasomotor nerve-endings. A reaction subsequently occurs, and the vessels become dilated and congested. When the drug becomes absorbed, the anæsthetic action ceases. Surface application does not induce anæsthesia of the deeper parts, nor does its effect last long.

When a solution of the drug is injected along the course of a nerve, it penetrates the nerve fibres and induces anæsthesia of the parts it supplies (regional anæsthesia); in this action it exhibits a remarkable selective affinity for the sensory fibres, as motor impulses can still pass along the nerve although with difficulty. Large amounts of the anæsthetic, however, paralyze both sensory and motor fibres. Solutions injected hypodermically may upon absorption induce toxic symptoms.

Internally, in small doses, cocaine is a stimulant, tonic, and restorative. The stimulation involves the whole central nervous system. Mental alertness and muscular power are increased, fatigue is removed, the respirations and heart's beat are accelerated, vascular constriction occurs, and blood-pressure rises.

TOXIC ACTIONS.—Cocaine is a general protoplasmic poison. In the horse, doses of from 60 to 80 grains, injected hypodermically, produce salivation, great excitement, quickened pulse, dilatation of the pupils, increase of reflex activity, and increased peristaltic action of the intestines. These effects pass off in about two hours.

Full doses may produce severe disturbances of respiration, and fatalities are usually associated with respiratory failure. Cocaine is slowly excreted and sublethal doses repeated in twenty-four hours or less may prove fatal.

ANTIDOTES.—The inhalation of amyl nitrite, stimulants such as ammonia and alcohol, and the hypodermic injection of ether. The symptoms may be so violent and severe that death occurs before antidotal treatment can be applied.

MEDICINAL USES.—*Externally*, cocaine is chiefly used as a local anæsthetic in minor surgical operations.

For the dog a 2½ per cent. solution may be used hypodermically for the painless removal of small tumours, etc. Stronger solutions are dangerous, as they may give rise to toxic symptoms. Because of the susceptibility of the dog to the toxic effects of cocaine other agents such as procaine (see p. 244) are preferred as local anæsthetics in canine practice.

In ophthalmic surgery, cocaine in 1 per cent. to 2 per cent. solution is applied to the eye at least twice before the operation is commenced. Foreign bodies in the eye are removed with facility after the local application of cocaine. In conjunctivitis,

in injuries to the cornea, and in corneal ulcer, the application of an eye-lotion containing 2 grains of cocaine and 10 grains of boric acid to the ounce of distilled water is employed in the early stages. Cocaine occasionally produces considerable irritation and vascular congestion in the eye after the primary effects have passed off, and for this reason other agents are preferable for ophthalmic work.

In the horse a $2\frac{1}{2}$ per cent. solution of cocaine is employed hypodermically as a local anæsthetic. From 12 to 15 minims may be injected at three or four points over the area of operation. For neurectomy the solution should be injected into the region of the nerve at the site selected for operation.

The maximum safe doses have been computed by Winslow as follows: By hypodermic injection—Horses, 10 grains; large dogs, 2 grains; small dogs, $\frac{3}{4}$ grain; cats, $\frac{1}{4}$ grain.

In surgical work it is well to keep within the maximum doses stated above. In the horse, when a large dose has been administered, the general restlessness and excitement consequent upon the primary stimulant action of the drug may render it impossible to keep the animal sufficiently still to permit of satisfactory operation.

The addition of a solution of adrenaline chloride by increasing the vaso-constriction limits the absorption and removal of the cocaine from the site of injection and so increases the local effect of a given dose. The addition of adrenaline to local anæsthetic solutions is now less commonly practised than formerly.

Cocaine is employed as an aid in the diagnosis of lameness; by injecting a solution over the course of the plantar nerves it can be determined whether the cause of lameness is in the foot. If the case be one of foot lameness, the animal will be rendered temporarily sound as the result of the injection. A $2\frac{1}{2}$ per cent. solution may be injected along the course of each plantar nerve above the fetlock.

As cocaine is a protoplasmic poison, the injection of strong solutions may be followed by necrosis of the part, and even weak solutions injected over the site of an operation wound will retard healing.

Solutions of cocaine do not keep well; it is therefore necessary to prepare them freshly when required for use. Tablets containing definite amounts of cocaine can be obtained commercially, and from these hypodermic injections can be conveniently prepared. Cocaine solutions, containing chloretone as a preservative, are also prepared, and remain active for a long period. Solutions of cocaine undergo decomposition if sterilized by boiling.

In carrying out local anæsthesia, strict aseptic precautions should be observed. As has been indicated, it is advisable to use weak solutions of the anæsthetic, as in some cases there is a tendency to cutaneous sloughing. When employing weak solutions a larger amount can be injected, and the infiltration of the tissues which results assists in the production of local anæsthesia. In order to obtain efficient local anæsthesia, careful attention to the technique is necessary, and a sufficiency of the anæsthetic should be injected. In the case of surgical interference with deep-seated structures, the injections should be made sufficiently deep, and at several points in the area of operation. A proper period of time (ten minutes) should be allowed before commencing to operate.

Procainæ Hydrochloridum (Procain. Hydrochlor.).—Novocain; Ethocaine. A hydrochloride of a derivative of para-amino-benzoic acid; $C_6H_4(NH_2)[CO_2.C_2H_4N.(C_2H_5)_2]HCl$. Colourless crystals. *Solubility*.—1 in 1 of water; 1 in 8 of alcohol.

Novocain is a local anæsthetic, and is employed as a substitute for cocaine. Solutions can be boiled without decomposition; its toxicity is about one-third that of cocaine, and it is non-irritant. A solution of 2 or 3 per cent. proves efficient as a local anæsthetic, and may be combined with a solution of adrenaline (1 to 30,000), as it does not itself cause constriction of the vessels. Novocain is also employed for the production of spinal anæsthesia (p. 477).

In the diagnosis of lameness in the horse, Winslow advises the injection of a 3 per cent. solution over the plantar nerve on either side of the limb.

Novocain is a comparatively safe local anæsthetic in canine surgery, and for this reason it has largely displaced cocaine. It is broken down in the liver and is not cumulative in action.

Amylocainæ Hydrochloridum (Amylocain. Hydrochlor.).—Stovaine. Benzoyl-ethyl-dimethyl-aminopropinol Hydrochloride; $C(CH_3)(C_2N_5)CH_2N(CH_3)_2O.CO.C_6H_5.HCl$. White crystals. *Solubility*.—1 in 13 of water.

Stovaine resembles novocain in its actions, but is somewhat irritant. It is employed for the production of spinal anæsthesia in isotonic solution prepared with 1 c.c. of 5 per cent. stovaine in 5 per cent. glucose, and also as a local anæsthetic in 2 per cent. to 4 per cent. solutions.

Benzaminæ Lactas.—Benzamine Lactate; β -Eucaine (*not official*); $C_{15}H_{21}NO_2.C_3H_5O_3$. The lactate of benzoyl-vinyl-diaceton-alkamine, by neutralizing with lactic acid.

Characters.—A white crystalline powder; taste slightly bitter, followed by numbness. *Solubility*.—1 in 5 of water; 1 in 8 of alcohol

90 per cent. Treated with HNO_3 and alcoholic KOH gives peppermint odour like cocaine. Triturated with alcohol 90 per cent. and HgCl does not darken (distinction from cocaine and α -eucaine). *Incompatibility*.—Salicylic acid.

ACTIONS AND USES.—Benzamine lactate is a local anæsthetic, resembling cocaine in this respect, but it is slower in its action and is less active. It possesses certain advantages over cocaine in that its toxicity is only about one-half that of cocaine, its local anæsthetic action is more prolonged and more constant, it does not dilate the pupil and does not produce the 'after-congestion' effects of cocaine, and its solutions can be sterilized by boiling without undergoing decomposition.

Quininæ et Ureæ Hydrochloridum (B.P.C.), a white, odourless powder.

This substance is employed as a local anæsthetic in $\frac{1}{2}$ to 1 per cent. solutions. It is non-irritating and non-toxic, and solutions above 1 per cent. maintain local anæsthesia for several days. After injection, a period of thirty minutes should be allowed before operative measures are commenced, as the action of the drug, although prolonged, is extremely slow.

Alcohol Tribromoethylicum (Alcoh. Tribromoethyl.).—Tribromoethyl alcohol; $\text{CBr}_3\text{CH}_2\text{OH}$.

Characters.—A white crystalline powder. M.p. 80°C . Soluble 1 in 35 of water at 40°C . A solution in amylene hydrate is known as bromethol, a colourless, syrupy liquid with a faint characteristic odour. This contains 1 gramme of tribromoethyl alcohol in 1 c.c. For use by rectal injection bromethol is diluted immediately before administration with thirty-nine times its own volume of distilled water at 40°C .

A solution of tribromoethyl alcohol in amylene hydrate has been marketed under the trade name of AVERTIN.

Doses.—Dog, grm. 0.42 to grm. 0.6 per kg. body-weight; cat, grm. 0.3 per kg. body-weight.

Tri-brom ethyl alcohol was introduced as a rectal narcotic and general anæsthetic for small animals when the site of operation is in the region of the mouth and face. The rectum is emptied by enema three hours before injection. Narcosis in the dog persists for about fifteen minutes to one hour, but in the cat it may continue for eighteen hours or longer. During narcosis there is a marked fall in temperature, and the body heat must be maintained. The routine use of this drug is now generally considered to be too dangerous to be justified.

Belladonna.

Belladonnæ Folium (Bellad. Fol.).—Belladonna Leaf. The leaves of *Atropa belladonna*, N.O. Solanaceæ; collected when the plant is in flower, and dried.

Characters.—8 to 20 cm. long; broadly ovate, acute, entire, nearly glabrous. Yield not less than 0.3 per cent. of alkaloids. *Substances resembling Belladonna Leaves.*—Stramonium leaves, more wrinkled; hyoscyamus leaves, which are hairy.

Composition.—Hyoscyamine; atropine; hyoscine; belladonnine.

Belladonna Pulverata (Bellad. Pulverat.).—Powdered Belladonna Leaf. Powdered Belladonna contains 0.3 per cent. of alkaloids calculated as hyoscyamine.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ss.; dogs, grs. ii. to grs. v.

Extractum Belladonnæ Siccum (Ext. Bellad. Sicc.).—Alcoholic (70 per cent.). *Standardized* to contain 1 per cent. of the alkaloids.

Doses.—Horses, grs. x. to grs. xv.; dogs, gr. $\frac{1}{4}$ to gr. i.

Tinctura Belladonnæ (Tinct. Bellad.).—Belladonna Leaves, Alcohol (70 per cent.), by percolation. *Standardized* to contain 0.03 g. alkaloids in 100 ml.

Doses.—Horses, \mathfrak{z} ss. to \mathfrak{z} i.; cattle, \mathfrak{z} i. to \mathfrak{z} ii.; sheep, \mathfrak{z} ss. to \mathfrak{z} i.; dogs, \mathfrak{M} v. to \mathfrak{M} xv.

Belladonnæ Radix (Bellad. Rad.).—Belladonna Root. The root of *Atropa belladonna*; collected in autumn and dried.

Characters.—Nearly cylindrical pieces, entire or longitudinally split, 10 to 20 mm. in diameter, and 15 to 30 cm. or more long; pale greyish-brown; finely wrinkled longitudinally. Fracture short. Internally whitish, starchy. Within, mostly near the cambium ring, many groups of vessels and fibres, without a prominently radiate arrangement. Taste slightly bitter. *Substances resembling Belladonna Root.*—Pyrethrum and scammony root (*q.v.*)

Composition.—Four alkaloids—viz., (1) *l*-hyoscyamine, $C_{17}H_{23}NO_3$, which is unstable and readily forms its isomer; (2) *atropine*; (3) *scopolamine* or *hyoscine*, $C_{17}H_{21}NO_4$; (4) *belladonnine*.

Extractum Belladonnæ Liquidum (Ext. Bellad. Liq.).—Aqueous and Alcoholic (90 per cent.). *Standardized* to contain 0.75 g. alkaloids in 100 ml. ($\frac{3}{4}$ gr. in 110 min.).

Doses.—Horses, \mathfrak{M} xx. to \mathfrak{M} xxx.; dogs, \mathfrak{M} i. to \mathfrak{M} v.

Linimentum Belladonnæ (Lin. Bellad.).—Belladonna Root, Camphor, Alcohol (90 per cent.), Distilled Water, of each a sufficient quantity. Contains 0.375 per cent. of alkaloids.

Unguentum Belladonnæ (*not official*).—Liquid Extract, 80 evaporated to 20; Benzoated Lard, 60; Wool Fat, 20. Contains 0.6 per cent. of alkaloids.

Atropina (Atrop.).—Atropine; $C_{17}H_{23}NO_3$. An alkaloid from *Atropa belladonna* or other plants of N.O. Solanaceæ.

Characters.—Colourless acicular crystals. **Solubility.**—1 in 500 of water; readily in alcohol 90 per cent., in chloroform and in ether. M.p. 115° C. Aqueous solution alkaline; powerfully dilates the pupil; and yields with solution of auric chloride a citron-yellow precipitate, which, when recrystallized from boiling water acidulated with HCl, has a minutely crystalline character, and when dry a

pulverulent appearance; m.p. 137° to 139° C. (distinction from hyoscyamine). Atropine evaporated with HNO_3 to dryness on water-bath gives yellowish residue, which becomes violet with alcoholic KOH solution. Solutions acidified with HCl do not become cloudy on adding NH_4OH (absence of apoatropine). It can be chemically resolved into *tropine*, $\text{C}_8\text{H}_{15}\text{NO}$, and *tropic acid*, $\text{C}_9\text{H}_{10}\text{O}_3$, and re-constructed from them. *Incompatibles*.—Caustic alkalies decompose it. Morphine, physostigmine, and pilocarpine are in various respects and degrees physiological antagonists of atropine.

Atropinæ Sulphas (Atrop. Sulph.).—Atropine Sulphate; $(\text{C}_{17}\text{H}_{23}\text{NO}_3)_2\text{H}_2\text{SO}_4$. The sulphate of the alkaloid atropine.

Characters.—Nearly colourless, crystalline, somewhat hygroscopic. *Solubility*.—1 in 1 of water; 1 in 4 of alcohol 90 per cent.

Doses (by hypodermic injection).—Horses, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$; dogs, gr. $\frac{1}{300}$ to gr. $\frac{1}{100}$; cats, gr. $\frac{1}{300}$.

Oculentum Atropinæ (Oculent. Atrop.).—Atropine Eye Ointment contains atropine sulphate 0.25 per cent.

Oculentum Atropinæ cum Hydrargyri Oxido (Oculent. Atrop. c. Hydrarg. Oxid.).—Atropine Eye Ointment with Mercuric Oxide contains atropine sulphate 0.125 per cent., yellow mercuric oxide 1 per cent.

ACTIONS OF BELLADONNA AND ATROPINE.

Externally, belladonna depresses the sensory nerve-endings, thus relieving pain and irritability in the part to which it is applied, and so acting as anodyne. This action, however, is slight unless the drug be applied in combination with alcohol or glycerin—i.e., in the form of a liniment. Locally applied to the functioning mammary gland, it was supposed to arrest the secretion of milk. It is now known that atropine has no such anti-galactagogue action, and that mammary secretion is independent of all nervous influences. Applied to the eye, it causes dilatation of the pupil and paralysis of accommodation; this effect, which is due to paralysis of the terminations of the third nerve in the iris and ciliary muscle, occurs whether the drug be applied locally or given internally.

Internally.—*Nervous System*.—The primary effect of the drug consists in stimulation of the motor areas of the cerebrum. Full doses in man produce a peculiar form of delirium, in which restlessness and a desire for action are combined with a sensation of lassitude. It also causes increased activity of the medullary centres, especially the respiratory and vasomotor centres, but when full doses are given these are later depressed.

In the horse, full doses cause excitement, delirium, and unsteady movements.

Spinal Cord.—The primary effect is that of slight stimulation of reflex excitability.

Atropine paralyzes the parasympathetic nerve terminals (see p. 60), so producing the following effects.

Eye.—Paralysis of the terminations of the third cranial nerve (motor oculi) in the sphincter of the pupil and in the ciliary muscle, resulting in dilatation of the pupil, paralysis of accommodation, and increase of the intra-ocular pressure due to occlusion of lymph-spaces by the dilated pupil.

Salivary Glands.—The peripheral nerve-endings of the chorda tympani nerve in the salivary glands are paralyzed, resulting in an arrest of salivation and dryness of the mouth and throat.

Other Secretory Glands.—Atropine has a similar effect on the gastric, intestinal, pancreatic, bronchial, and sweat glands.

Oesophageal, Gastric, and Intestinal Musculature.—By depressing the vagal terminations, atropine, while causing no interference with normal peristalsis, overcomes violent spasmodic movements; it is thus carminative.

Heart and Circulation.—Atropine, by causing paralysis of the peripheral terminations of the vagi, accelerates the heart-beat, but does not diminish its force.

Because of the stimulation of the medulla, vaso-constriction of central origin occurs, and the blood-pressure is raised.

Respiration.—Because of the stimulation of the respiratory centre, the respirations become quicker and deeper. Toxic doses paralyze the centre. In consequence of paralysis of the terminations of the vagi, the bronchial muscles relax (efferent fibres), and sensibility is decreased (afferent fibres). As already indicated, bronchial secretion is diminished.

Temperature.—A full dose of atropine may cause a rise in temperature, due to direct stimulation of the thermogenic centre.

Excretion.—Atropine is rapidly excreted in the urine, and during its passage through the ureters, bladder, and urethra it exerts remote local anodyne effects.

TOXIC ACTIONS.—In the horse, large doses of belladonna or atropine produce restlessness, delirium, dryness of the mouth, quick pulse, gradually becoming thready; quick, short respirations, increase of temperature, and dilatation of the pupils; frequent micturition; no hypnotic effects have been observed. When the drug is administered in the crude form in large doses, symptoms of abdominal pain are also observed. Six ounces of the dried root have proved fatal in the horse.

Atropine sulphate, administered by hypodermic injection in doses of 2 grains, caused great acceleration and weakness of the pulse, twitching of the superficial muscles, nervous excitement, occasional hiccough, and dryness of the mouth. These symptoms

gradually disappeared, but the pupils remained dilated for twenty-four hours.

In the dog, the symptoms observed are marked acceleration and progressive enfeeblement of the pulse, irregular and shallow respiration, prostration; death occurs in convulsions. The results of experiments indicate that about $\frac{3}{4}$ grain of atropine is a toxic dose for the dog, but $\frac{1}{80}$ grain to $\frac{1}{60}$ grain have produced sub-toxic symptoms. Fifteen grains of the extract of belladonna have also proved fatal.

ANTIDOTES.—In the dog, if the case be seen early, a rapidly acting emetic—*e.g.*, apomorphine—should be promptly administered. Stimulants such as brandy and ammonia are indicated. Pilocarpine (by hypodermic injection) is a physiological antidote. Other measures consist in artificial respiration, the application of the hot and cold douche alternately to the head, and the judicious employment of the galvanic battery.

Retention of the urine may occur in atropine-poisoning, and the bladder may require to be relieved by catheter.

MEDICINAL USES.—*Externally*, as a local anodyne, the extract of belladonna, combined with glycerin, is extensively employed in the treatment of acute painful conditions.

In mastitis it is of some value as a local application. In subacute cases it may be applied in the form of a liniment composed of the liquid extract, 2 drachms; glycerin, 2 ounces; and soap liniment, 3 ounces.

Atropine is frequently used as a component of anodyne collyria, but its mydriatic effect is usually highly undesirable, and other agents are more effective anodynes.

Care is necessary in applying belladonna externally in canine practice, as toxic symptoms may occur should the dog lick the parts to which the agent is applied.

Internally, in the treatment of gastritis in horses and cattle belladonna is of service. Combined with bicarbonate of soda, it may be usefully employed in inflammation of the abomasum in cattle. It is recommended as an anodyne in acute abdominal pain in the horse, but its effects in moderate doses are of little value in such cases, and if larger doses be employed excitement is produced.

Atropine may be combined with morphine, the anodyne effect of which is believed to become enhanced, while some of its undesirable actions are counteracted.

Full doses of belladonna interfere with peristalsis, and are therefore contra-indicated in colic depending on obstruction of the intestines.

As an antisialic, belladonna is employed in mercurial saliva-

tion, but since this results from the irritant action of the mercury on the salivary glands, and thus represents a defensive reaction, antisialics are contra-indicated. It is also used as a mouth-wash in inflammation of the buccal mucous membrane, but its action in arresting salivary secretion renders it unsuitable for this purpose. The same objection applies to the use of belladonna in electuaries for the relief of pharyngitis and laryngitis.

In bronchitis, accompanied by spasmodic cough, belladonna frequently affords considerable relief to the patient, while it does not depress the respiratory centre.

Atropine is administered for obstruction and spasm of the oesophagus in the horse.

When combined with powerful purgatives, belladonna controls their violent action and prevents griping.

Atropine is indicated in irritable and inflamed conditions of the bladder.

In functional constriction of the cervix uteri, the extract of belladonna, freely applied to the part, may overcome the spasm and permit delivery to take place.

In cardiac palpitation and functional irregularity of the heart belladonna frequently gives relief. Previous to the administration of chloroform, atropine may be given to check excessive bronchial and salivary secretion and overcome the inhibitory effects on the heart produced by excessive vagus stimulation during the earlier phases of anæsthesia.

In tetanus, the administration of belladonna in the form of an electuary occasionally appears to be of some benefit.

It has been used with success in overcoming the vagotonia associated with the development of anaphylactic shock, such as may arise from the use of heterologous antisera.

Atropine is an antidote to morphine-poisoning, and is the physiological antidote to the toxic effects of physostigmine pilocarpine, and arecoline.

Homatropinæ Hydrobromidum (Homatrop. Hydrobrom.).—Homatropine Hydrobromide; $C_{16}H_{21}NO_3 \cdot HBr$. The hydrobromide of an alkaloid prepared from tropine and mandelic acid.

Characters.—A white crystalline powder or aggregation of minute crystals. **Solubility.**—1 in 6 of water; 1 in 18 of alcohol (90 per cent.); solutions neutral. A 1 per cent. aqueous solution powerfully dilates the pupil. Treated with HNO_3 and alcoholic KOH, a reddish-yellow colour is produced not changing to violet (distinction from atropine). Homatropine alkaloid gives yellow then brick-red if warmed with alcoholic (60 per cent.) $HgCl_2$ solution.

Homatropine is sometimes substituted for atropine in ophthalmic practice, since its mydriatic effect is produced more

quickly than that of atropine and passes off in one-fourth the time. It is applied in soft gelatin lamellæ, each of which contains $\frac{1}{100}$ grain of homatropine hydrobromide.

Hyoscyamus.

Hyoscyamus (Hyoscy.).—Hyoscyamus Leaves; Henbane Leaves. The leaves of *Hyoscyamus niger*, N.O. Solanaceæ, collected from the flowering plants and dried.

Characters.—Leaves of various lengths, seldom exceeding 25 cm.; mostly sessile; exstipulate; triangular-ovate or ovate-oblong, acute; undulated, irregularly toothed, sinuate, or pinnatifid; midrib conspicuous; pale green and glandular-hairy, particularly beneath; odour strong, characteristic; taste bitter, slightly acrid. *Substances resembling Hyoscyamus.*—See Belladonna and Stramonium.

Composition.—The active principles are: (1) *l*-hyoscyamine, $C_{17}H_{23}NO_3$, a crystalline alkaloid, which readily forms its racemic isomer atropine; (2) *hyoscine* or *scopolamine*, $C_{17}H_{21}NO_4$, a syrupy alkaloid forming crystalline salts; and (3) *atropine*. *Incompatibles.*—Vegetable acids, silver nitrate, lead acetate, and liquor potassæ.

Extractum Hyoscyami Siccum (Ext. Hyoscy. Sicc.).—Extract of Hyoscyamus, Alcoholic (70 per cent.). *Standardized* to contain 0.3 per cent. of the alkaloids.

Doses.—Horses and cattle, grs. x. to grs. xl.; dogs, gr. $\frac{1}{4}$ to gr. i.

Tinctura Hyoscyami (Tinct. Hyoscy.).—Liquid Extract of Hyoscyamus; Alcohol, 70 per cent.; by percolation contains 0.005 per cent. of the alkaloids calculated as hyoscyamine.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, \mathfrak{M} x. to \mathfrak{M} xl.

Extractum Hyoscyami Liquidum (Ext. Hyoscy. Liq.).—Liquid Extract of Hyoscyamus contains 0.05 per cent. of the alkaloids calculated as hyoscyamine.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, \mathfrak{M} x. to \mathfrak{M} xl.

Hyoscyaminæ Sulphas (not official).—Hyoscyamine Sulphate; $(C_{17}H_{23}NO_3)_2 \cdot H_2SO_4 \cdot 2H_2O$.

Source.—The sulphate of an alkaloid (*l*-hyoscyamine) obtained from hyoscyamus leaves and other Solanaceæ.

Characters.—A crystalline deliquescent powder. **Solubility.**—1 in 0.5 of water. Solution in water acidified with HCl yields with solution of auric chloride a yellow precipitate, which if recrystallized forms brilliant, golden-yellow scales; m.p. 165° C. (distinction from atropine); with HNO_3 and alcoholic KOH gives violet colour like atropine.

Doses (by hypodermic injection).—Horses, gr. $\frac{1}{20}$ to gr. $\frac{1}{10}$; dogs, gr. $\frac{1}{200}$ to gr. $\frac{1}{100}$.

Hyoscine Hydrobromidum (Hyoscin. Hydrobrom.).—Hyoscine Hydrobromide; Scopolamine Hydrobromide; $C_{17}H_{21}NO_4 \cdot HBr \cdot 3H_2O$.

Source.—Obtained from hyoscyamus leaves, and various other solanaceous plants.

Characters.—Small, colourless, transparent, non-deliquescent rhombic crystals. **Solubility.**—1 in 4 of water. Aqueous solution gives with NaOH solution, not with NH_4OH , a white precipitate, soluble in excess of NaOH. When removed by $CHCl_3$ from ammoniacal

solution, alkaloid dissolved in dilute HCl gives with auric chloride solution a yellow crystalline precipitate having a melting-point of 198° to 200° C. With HNO_3 and alcoholic KOH it gives violet colour like atropine.

DOSES (*by hypodermic injection*).—Horses, gr. $\frac{1}{20}$ to gr. $\frac{1}{10}$; dogs, gr. $\frac{1}{200}$ to gr. $\frac{1}{100}$.

ACTIONS AND USES.—As its composition indicates, hyoscyamus resembles belladonna in its actions, but since it contains a considerable proportion of hyoscyne, a powerful cerebral and spinal sedative, the excitement and delirium occasionally produced by belladonna are seldom occasioned by hyoscyamus. Its carminative effect is more pronounced than that of belladonna, and it possesses more decided remote local anodyne effects on the urinary organs.

Hyoscyamine resembles atropine in its effects on the parasympathetic nerve terminals.

In combination with morphine, hyoscyamine is employed as a sedative in the horse, and in canine practice as an anæsthetic.

Its toxicity for dogs and cats appears to be comparatively low, and $7\frac{1}{2}$ grains administered to a small cat did not prove fatal.

As an aid in obstetric operations in cows, Winslow advises the hypodermic injection of $\frac{1}{8}$ grain of hyoscyamine hydrobromide with 1 grain of morphine sulphate. The injection may be repeated in twenty minutes. Hyoscyne may be also given hypodermically ($\frac{1}{8}$ to $\frac{1}{4}$ grain) to horses half an hour before chloroform anæsthesia with the object of diminishing the phase of excitement.

In irritability of the bladder and genito-urinary organs, hyoscyamus is prescribed in combination with alkalies such as bicarbonate of potassium or sodium. In cystitis and in strangury arising from the absorption of cantharidin after the application of a blister, hyoscyamus is prescribed, with alkalies and demulcents.

In canine practice it is sometimes combined with purgatives in order to prevent griping. For example, it is combined with compound colocynth pill to form the *Pil. Colocynthidis Composita et Hyoscyami*.

Stramonium.

Stramonium (*Stramon.*).—*Stramonium* Leaves. The dried leaves of *Datura stramonium*, N.O. Solanaceæ.

Characters.—Ovate, petiolate, 10 to 15 cm. long, apex acuminate, unequal at base; margin sinuate-dentate; upper surface dark greyish-green, under surface paler, minutely wrinkled. Odour characteristic; taste unpleasant, bitter.

Composition.—The leaves contain chiefly *hyoscyamine* along with *atropine* and *hyoscyne* (scopolamine). *Daturine*, the name previously

applied to the principal alkaloid, is probably a mixture of atropine and *d*- or *l*-hyoscyamine.

Tinctura Stramonii (Tinct. Stramon.).—*Stramonium* Leaves; Alcohol, 45 per cent.; by percolation.

Doses.—Horses, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$.; dogs, $\mathfrak{M}\text{v}$. to $\mathfrak{M}\text{xx}$.

Stramonium closely resembles belladonna in its actions, but possesses a more marked depressant effect on the vagal terminations in the bronchi, and thus effects a greater relaxation in the bronchial muscles.

It has been found useful in spasmodic asthma, but is seldom employed in veterinary practice.

Tobacco.

Tabaci Folia.—Leaf Tobacco (*not official*).

The dried leaves of the Virginian tobacco, *Nicotiana tabacum*. Contains about 6 per cent. of *nicotine*.

Nicotina.—*Nicotine* (*not official*).

A colourless, volatile, liquid alkaloid, the active principle of tobacco.

Nicotinæ Sulphas.—*Nicotine Sulphate* (*not official*). *Nicotine Sulphate* is usually obtained as a 40 per cent. solution.

ACTIONS.—*Externally*, tobacco is antiseptic and parasiticide.

Internally, nicotine causes stimulation, and later depression, of all ganglionic nerve-cells (sympathetic and para-sympathetic); thus there first occur slowing of the pulse-rate (stimulation of the vagal ganglia), and an increase in blood-pressure (stimulation of the splanchnic ganglia), increase in glandular secretion (peripheral secretory ganglia), and increase in peristalsis (vagal ganglia).

When the primary stimulation has passed off, and ganglionic depression and paralysis commence, the heart-beat becomes accelerated, blood-pressure falls, and there is a marked diminution in peristalsis and glandular secretion, but peristalsis may later return in an exaggerated form due to the removal of inhibiting influences resulting from paralysis of the sympathetic ganglia.

Nicotine is generally regarded as a myotic, but its action upon the pupil is inconstant.

Toxic ACTIONS.—*Nicotine* is a very powerful poison. From 5 to 6 minims are said to prove toxic to the horse, and from 1 to 3 minims to the dog.

Nicotine-poisoning has occurred from the use of strong infusions of tobacco as parasiticide washes, and the mule appears to be particularly susceptible to the toxic action of the drug. Tobacco has also caused toxic symptoms when administered as

a vermicide to the dog. It acts as a severe gastro-intestinal irritant, producing vomiting and catharsis, and these symptoms are accompanied by tremors, clonic convulsions, and great muscular weakness. The pulse, at first slow, later becomes accelerated and progressively weak. Respirations are rapid and shallow. The temperature falls, and collapse supervenes. Death results from respiratory failure.

ANTIDOTES.—In the dog, emetics, preferably apomorphine, followed by tannic acid or strong tea; the hypodermic injection of caffeine; stimulants, such as alcohol and sal volatile. The surface of the body should be kept warm.

MEDICINAL USES—*Externally*, as a parasiticide, decoctions of tobacco were employed in the treatment of mange, and for the destruction of lice, ticks, and fleas, but probably because of the volatility of nicotine, tobacco is of little value as an acaricide. A solution of nicotine has been used in the treatment of pediculosis in army horses. One part of a 20 per cent. solution of the drug is diluted with 200 parts of water, and applied to the skin with a brush, using friction. Previous to the application the hair should be singed and the skin washed with hard soap and warm water, and then dried. The dressing is repeated at intervals of three days, until four applications have been made, the parts being washed with soap and water previous to each dressing.

Nicotine sulphate 1 part, powdered chalk 99 parts, is effective as a dusting powder in lice in poultry.

Internally, tobacco in the form of an infusion, prepared with 4 ounces in a pint of boiling water, then cooled and strained, has been found successful as an antidote to strychnine-poisoning in the dog, and may be employed in a case of emergency when other antidotes are not available.

The addition of nicotine sulphate to copper sulphate solutions employed in the treatment of strongylosis of the stomach and bowel of ruminants has given good results and the combination is now in general use.

The doses of the 40 per cent. solution of nicotine sulphate are similar to those of copper sulphate (see p. 143 and Appendix I., p. 490), being used in the form of a solution containing 1 per cent. of copper sulphate and 1 per cent. of nicotine sulphate (40 per cent. solution). This treatment is also effective against tapeworm in cattle and sheep.

Tobacco is advised in *ascaris* and *heterakis* infestations of poultry. The following constitutes a 'mass treatment': For 100 birds, 1 pound of tobacco is steeped in water. This is mixed with a 'wet mash,' and is offered to the birds after previously fasting them for twenty-four hours. A few hours later

the birds are given another mash, to which a solution of magnesium sulphate has been added. The treatment should be repeated in ten days.

Lobelia.

Lobelia (Lobel.).—*Lobelia*. The dried aerial parts of *Lobelia inflata*, N.O. *Lobeliaceæ*.

Characters.—Stems angular, channelled, with narrow wings; often purplish, with 1-celled hairs and scars of alternate leaves. Leaves irregularly toothed, hairy. Capsules inflated, 2-celled; containing when ripe minute, oblong, reticulated brown seeds. Odour somewhat irritating; taste at first not marked, but later burning and acrid.

Composition.—It contains *lobeline*, $C_{18}H_{23}NO_2$, an oily, liquid, volatile alkaloid, with a pungent taste, and an odour like that of tobacco. *Lobelic acid* is united with the lobeline. *Incompatibles*.—Caustic alkalies, which decompose lobeline.

Tinctura Lobeliæ Ætherea (Tinct. Lobel. Æther.).—*Lobelia* in Spirit of Ether; by percolation.

Dose.—Dogs, ℥v. to ℥xx.

Lobeline resembles nicotine in that it first stimulates and later depresses ganglionic nerve-cells. The secondary depressant action on the vagus ganglia induces marked relaxation of the bronchioles; for this reason the tincture is occasionally given to relieve the bronchial spasm of asthma in the dog. Lobeline sulphate in doses of gr. $\frac{1}{160}$ to gr. $\frac{1}{10}$ has been used as a stimulant to the respiratory centre in respiratory failure during chloroform anæsthesia.

Conium.

Coniine.— $C_8H_9(C_3H_7)NH$ (*not official*). A liquid alkaloid obtained from *Conium maculatum*, the spotted hemlock, N.O. *Umbelliferæ*.

Coniine resembles nicotine and lobelia in its actions, but has now fallen into almost complete disuse in veterinary practice.

The symptoms observed in poisoning by hemlock are muscular weakness, drooping and swelling of the eyelids, dilatation of the pupils, and general paralysis.

The ANTIDOTES are tannic acid and alcoholic stimulants. The animal should be kept warm.

Formerly conium was prescribed in tetanus and in the treatment of spasmodic cough, but proved of little, if any, value.

Scoparium.

Scoparii Cacumina.—Broom Tops (*not official*). The fresh and the dried tops of *Cystisus scoparius*, N.O. *Leguminosæ*.

Characters.—Stem dark green; branches long, straight, slender, alternate; the latter, like upper part of stem, winged, tough, flexible, glabrous. Leaves, when present, small, sessile, simple above, stalked

and trifoliate below. Odour of fresh tops, especially when bruised, characteristic; dry tops almost odourless. Taste bitter, nauseous.

Composition.—Scoparium contains *scoparin* and *sparteine*, and other matters. Scoparin, $C_{20}H_{20}O_{10}$, is a yellow crystalline neutral body. Sparteine, $C_{15}H_{26}N_2$, is a volatile, oily liquid alkaloid, allied in appearance, composition, and action to conine.

ACTIONS AND USES.—An infusion of broom (10 per cent.) is diuretic.

Sparteine, although possessing actions similar to conine, is much less toxic. It exerts very little effect on the central nervous system, but in large doses paralyzes sympathetic ganglia and the peripheral terminations of motor nerves. Sparteine sulphate has been employed in pneumonia. It is said to increase the force of the heart's action without raising blood-pressure, but later experiments show that it has no action as a cardiac tonic. The diuretic action of scoparium, which was attributed to the supposed effects of sparteine on the circulation, is now believed to be due to scoparin.

Gelsemium.

Gelsemii Radix.—Yellow Jasmine (*not official*). The dried rhizome and roots of *Gelsemium nitidum*, N.O. Loganiaceæ.

Characters.—Nearly cylindrical pieces, 15 cm. or more long, 6 to 18 mm. thick; occasionally with fibrous rootlets attached. Fracture splintery. In transverse section a thin cortex and a porous yellowish wood, distinctly radiate with many conspicuous straight medullary rays. Rhizome with a brown or dark brownish-violet cork, often much fissured; nearly straight, exhibiting silky fibres in bast. Root yellowish-brown, finely wrinkled, somewhat tortuous. Odour slightly aromatic; taste bitter.

Composition.—Alkaloids: *gelseminine*, $C_{22}H_{26}N_2O_3$, a potent poison acting like coniine; *gelsemine*, $C_{12}H_{14}NO_2$, acting like strychnine; *gelsemoidine*; *gelsemic acid*, $C_9H_5(CH_3)O_4$; oils, resins, and fats.

Tinctura Gelsemii (*not official*).—10 in 100 of Alcohol 60 per cent.: by percolation.

Doses.—Horses, ʒss. to ʒi.ss.; dogs, ℥x. to ℥xxx.

ACTIONS AND USES.—Gelsemium closely resembles coniine in its actions, but is more depressant to the central nervous system. When applied locally it causes dilatation of the pupil and paralysis of accommodation, probably by depressing the endings of the oculomotor nerve. In this it resembles atropine, but, unlike atropine, it affects other autonomic nerves by acting upon their ganglia, and not upon their terminations. It has been used in cerebrospinal meningitis and tetanus, but its value is very doubtful.

Physostigmine.

Physostigminæ Salicylas (*Physostig. Salicyl.*).—Physostigmine Salicylate; Eserine Salicylate. The salicylate of an alkaloid, physostigmine, obtained from Calabar bean, the seed of *Physostigma venenosum* (Leguminosæ).

Characters.—Minute white crystals, becoming yellowish on exposure to air and light, very deliquescent. *Solubility.*—Readily in water; and in alcohol 90 per cent. Aqueous solution neutral; yields with dilute NaOH a white precipitate turning pink, or a red solution. A fragment forms yellow solution with fuming HNO_3 , which on warming turns orange, blood-red, and leaves green residue.

Doses.—Horses and cattle, gr. ss. to grs. ii., by hypodermic injection. If administered by intravenous injection, the smaller dose should be employed. The drug is not used internally in canine practice.

ACTIONS.—Physostigmine inhibits the ferment esterase from inactivating acetylcholine. This appears to explain why physostigmine will not act on denervated organs, since in them no acetylcholine is produced.

Central Nervous System.—Physostigmine, after probably inducing a slight initial stimulation, is a depressant to the central nervous system. The depression begins in the cord and spreads upwards to the medulla and to the cerebrum, which, however, is only affected by large doses.

Autonomic Nervous System.—The effects of physostigmine are those of stimulation of parasympathetic nerve-endings (p. 60); therefore the more important effects which it produces are myosis, increased glandular secretion, retardation of the heart, bronchial constriction, and purgation.

The Eye.—Physostigmine, whether applied locally or injected intravenously or subcutaneously, causes contraction of the pupil and spasm of accommodation by stimulation of the endings of the third cranial nerve. Intra-ocular pressure is diminished.

Secretion.—The secretions of all glands are increased by physostigmine; thus the saliva, mucous secretion, tears, sweat, and pancreatic juice are all augmented. This increased secretion depends upon the apparent stimulation of the secretory nerve-endings of the parasympathetic.

Muscles.—On striped muscle physostigmine produces fibrillary contractions or tremors due to excitation of the motor nerve-endings. The tremors disappear under curare, and are antagonized by atropine and calcium, although these agents have no action upon the nerve-endings in striped muscle.

Because of the parasympathetic stimulation involuntary muscle is excited, and this is evidenced by increased peristalsis and purgation, contraction of the bronchial tubes, uterus, bladder, and iris muscle.

Circulation.—The pulse-rate is slowed, due to stimulation of the vagus, and also to a direct action of the drug on the cardiac muscle.

The blood-pressure is raised, due to direct constriction of the

vessels, to the powerful intestinal contractions, and also to some extent to stimulation of the vasomotor centre.

Respiration.—Respiratory movements are at first accelerated and then retarded and reduced in strength. The primary stimulation possibly arises from excitation of the centre due to partial asphyxiation induced by the bronchial constriction. The centre is later depressed and death results from asphyxia.

Excretion.—Physostigmine is largely destroyed in the tissues, but a proportion is excreted in the urine, saliva, and bile.

Antagonism.—Atropine is the physiological antagonist to physostigmine in that it depresses all parasympathetic nerve-endings, so preventing the production of acetylcholine.

TOXIC ACTIONS.—Toxic doses cause profuse sweating, convulsive breathing, and in some cases spasm of the diaphragm. Death has occurred in the horse after the administration of 8 grains hypodermically.

MEDICINAL USES.—*Externally*, physostigmine is employed to diminish intra-ocular pressure in such conditions as ulceration of the cornea, glaucoma, and staphyloma. Used alternately with atropine, or preferably homatropine, it is useful to prevent and to break down adhesions consequent upon iritis. A collyrium employed for this purpose is prepared with 2 grains of physostigmine sulphate dissolved in 1 ounce of distilled water, but as its application to the eye may cause considerable pain, pilocarpine is preferable to physostigmine in ophthalmic practice.

Internally, in the horse, the action of physostigmine on the gastro-intestinal canal is usually prompt and constant. The average medicinal dose, from 1 to 1½ grains, administered by hypodermic injection, generally acts in from twenty minutes to an hour. If given by intravenous injection its effects are more quickly produced. Slight colicky pains, borborygmi, and the passage of flatus, are the first indications of its action; these are followed by evacuation of the contents of the rectum, succeeded at intervals by motions which are softer and more watery in consistence. The colicky pains may continue, and, in addition, there may be straining, especially if a firm impaction be present in the intestine. The symptoms pass off in from two to two and a half hours, and in favourable cases a very large amount of fæces is evacuated.

Physostigmine is chiefly used in veterinary practice in the treatment of colic in the horse depending on impaction of the intestine. In selected cases it is of great value; but if intestinal obstruction depends on mechanical causes, such as volvulus, intussusception, or calculus, the action of the drug hastens the

fatal termination. In cases which present evidence of enteritis the drug is also contra-indicated.

In pregnant animals the administration of physostigmine may occasionally cause expulsion of the fœtus; but if the mother's life be of more importance, physostigmine may be prescribed without hesitation, provided indications for its use are present. In many instances it is safer to give repeated small doses of the drug, especially when intestinal tympany is present. Doses of $\frac{1}{2}$ grain may be repeated every half-hour if necessary until 2 grains have been given.

In pulmonary emphysema physostigmine should be prescribed with caution, as its administration may cause extreme dyspnoea, due to the constriction of the bronchioles. Should this occur, atropine should be at once administered hypodermically.

In cattle, physostigmine causes painful straining, but it does not produce free purgation. It is employed in impaction of the rumen in $\frac{3}{4}$ grain doses hypodermically.

Pilocarpine.

Pilocarpinae Nitras (Pilocarp. Nit.).—Pilocarpine Nitrate; $C_{11}H_{16}N_2O_2 \cdot HNO_3$. The nitrate of an alkaloid, pilocarpine, obtained from the leaves of *Pilocarpus microphyllus* and other species of *Pilocarpus* (Jaborandi), N.O. Rutaceæ.

Characters.—A white crystalline powder. *Solubility*.—1 in 8 of water. M.p. 176° C. With H_2SO_4 yields a colourless solution turning green on adding K_2CrO_4 ; an aqueous solution with dilute H_2SO_4 , H_2O_2 , benzene and K_2CrO_4 solution gives, when shaken, bluish-violet in the benzene.

Doses.—Horses, grs. ii. to grs. iii.; dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{3}$; administered by hypodermic injection.

ACTIONS—Autonomic Nervous System.—Pilocarpine appears to stimulate the terminations of all parasympathetic nerves (see p. 60); it also apparently acts directly on the cells of the organs concerned, since it continues to act after denervation. It therefore excites the movements and augments the tone of plain muscle, and also markedly increases the secretions.

The Eye.—Pilocarpine causes contraction of the pupil and ciliary muscle, whether applied locally or administered internally. This action depends on stimulation of the nerve terminals of the motor oculi. The intra-ocular pressure is diminished.

Secretions.—The parasympathetic stimulation results in an increase of the salivary, lachrymal, gastric, intestinal, pancreatic, and mucous secretions. The sweat-glands, while apparently receiving their innervation from the sympathetic, are activated by parasympathetic stimulants—e.g., physostigmine, pilocarpine.

Plain Muscle.—The stimulation of the intestine leads to increased peristalsis and active purgation. The bronchi are constricted, the tone of the ureters, bladder, and pregnant uterus is augmented.

The Circulation.—The heart is slowed by vagal stimulation, but in the dog cardiac acceleration, instead of inhibition, occasionally occurs after pilocarpine. It has been suggested that this effect arises from the nausea which may result from the increased gastric movements.

The peripheral vessels are dilated, but vascular constriction occurs in the splanchnic area.

Respiration.—Toxic doses cause constriction of the bronchioles and a free secretion from the bronchial mucosa, so that respiration becomes dyspnoëic, and râles are heard throughout the area of pulmonary auscultation.

Antagonism.—Atropine is physiologically antagonistic to pilocarpine, and is capable of abolishing all its effects. It is, therefore, the most effective antidote in pilocarpine-poisoning.

MEDICINAL USES.—*Externally*, as a collyrium (2 grains to the ounce of distilled water), pilocarpine is occasionally used as a substitute for physostigmine and is less painful.

Internally, pilocarpine is chiefly used in veterinary practice in the treatment of intestinal impaction in the horse. For this purpose it is sometimes combined with physostigmine, the action of which it augments. Its action on the intestinal glands is more marked than that of physostigmine, but it has less effect on the muscular coat of the intestine. As pilocarpine does not produce marked sudorific effects in animals, its therapeutic value is limited, and it is not found of service in the treatment of renal dropsy or of uræmia, conditions for which it proves useful in human medicine. The drug is seldom used internally in canine practice.

Three other alkaloids which closely resemble physostigmine and pilocarpine in their actions are:

MUSCARINE, obtained from a poisonous mushroom, *Agaricus muscarius*, is not used in medicine.

CHOLINE, formed during the breakdown of leithicin in the tissues, has a comparatively feeble action, but its derivative, acetylcholine, has a powerful stimulant effect on vagal nerve-endings. It has been suggested that acetylcholine acts as a hormone, and is concerned in the maintenance of normal peristalsis.

ARECOLINE is discussed on p. 317.

Nux Vomica.

Nux Vomica (Nux. Vom.).—Nux Vomica. The dried ripe seeds of *Strychnos nux-vomica*, N.O. Loganiaceæ.

Characters.—Disc-shaped, ash- or greenish-grey seeds, 2 to 2.5 cm. in diameter, 6 mm. thick, concavo-convex, nearly flat, or sometimes irregularly bent, rounded or somewhat acute at the margin, from a small prominence on which a raised line passes to the central hilum. Surface covered with short, satiny, radiately arranged, closely appressed hairs. Endosperm large and horny; cotyledons small and leafy. No odour; taste extremely bitter. Yields not less than 1.25 per cent. strychnine.

Composition.—Nux vomica contains two alkaloids—*strychnine* and *brucine*, united with a crystalline acid, *strychnic*, *igasuric*, or *caffeotannic acid*; and a glucoside, *loganin*.

Nux Vomica Pulverata (Nux. Vom. Pulverat.).—Pulvis Nucis Vomicae. Adjusted to contain 1.2 per cent. of strychnine.

DOSES OF POWDERED NUX VOMICA.—Horses (stomachic), grs. xx. to 3i. (intestinal stimulant, ʒss. to ʒi.); cattle, ʒi. to ʒii.; sheep, grs. x. to grs. xx.; pigs, grs. x. to grs. xv.; dogs, gr. ss. to grs. iii. Repeated twice daily.

Extractum Nucis Vomicae Liquidum (Ext. Nuc. Vom. Liq.).—Alcoholic; by repercolation process. *Standardized* to contain 1.5 g. of strychnine in 100 ml. (1.5 gr. in 110 min.).

DOSES.—Horses, ʒxx. to ʒi.; cattle, ʒi. to ʒi.ss.; sheep, ʒx. to ʒxx.; pigs, ʒviii. to ʒxv.; dogs ʒss. to ʒi.

Extractum Nucis Vomicae Siccum (Ext. Nuc. Vom. Sicc.).—Made by evaporating the Liquid Extract and adding Calcium Phosphate. *Standardized* to contain 5 per cent. of strychnine.

DOSES.—Horses, grs. v. to grs. xx.; cattle, grs. x. to grs. xxv.; sheep, grs. ii. to grs. v.; pigs, gr. i. to grs. iii.; dogs, gr. ʒv to gr. ʒv.

Tinctura Nucis Vomicae (Tinct. Nuc. Vom.).—Liquid Extract; Water; Alcohol 90 per cent. *Standardized* to contain 0.125 g. strychnine in 100 ml. (1.25 gr. in 1 fl. dr.).

DOSES.—Horses, ʒss. to ʒi.; cattle, ʒi.; sheep, ʒxv. to ʒi.; pigs, ʒv. to ʒxx.; dogs, ʒii. to ʒx.

Strychnina.—Strychnine (*not official*); $C_{21}H_{22}N_2O_2$. An alkaloid obtained from the seeds of nux vomica and other species of *Strychnos*.

Characters and Tests.—Colourless, transparent, prismatic crystals, permanent in air; inodorous. **Solubility.**—Very sparingly in water, but imparts to it an intensely bitter taste; 1 in 150 of cold, but in 12 of boiling alcohol 90 per cent.; sulphuric acid forms with it a colourless solution, which on the addition of potassium bichromate acquires an intensely violet colour, passing to red and yellow. Forms colourless solution with H_2SO_4 , which with HNO_3 gives no more than a faint pink colour (limit of brucine). **Impurities.**—Brucine; mineral matter.

Strychninae Hydrochloridum (Strych. Hydrochlor.).—Strychnine Hydrochloride; $C_{21}H_{22}N_2O_2 \cdot HCl \cdot 2H_2O$. The hydrochloride of the alkaloid strychnine.

Characters.—Small, colourless, prismatic crystals. *Solubility*.—1 in 60 of water, solution neutral; taste intensely bitter. *Impurities*.—Sulphates.

Doses.—*By the mouth*: Horses and cattle, gr. ss. to gr. i.; sheep, gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$; pigs, gr. $\frac{3}{32}$ to gr. $\frac{1}{16}$; dogs, gr. $\frac{3}{320}$ to gr. $\frac{1}{80}$. *By hypodermic injection* (and this is the usual mode of administration) the minimum doses should be given.

Liquor Strychninæ Hydrochloridi (Liq. Strych. Hydrochlor.).—Strychnine Hydrochloride; Alcohol 90 per cent.; Distilled Water; 1 gr. strychnine hydrochloride in 110 min.

Doses.—*By the mouth*: Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ii.; sheep, \mathfrak{M} xx. to \mathfrak{M} xxx.; pigs, \mathfrak{M} iii. to \mathfrak{M} x.; dogs, \mathfrak{M} ss. to \mathfrak{M} ii.

By hypodermic injection: Horses and cattle, \mathfrak{z} i.; sheep \mathfrak{M} xx.; pigs, \mathfrak{M} v.

STRYCHNINE SULPHATE (*not official*) is administered in doses similar to those of the hydrochloride.

The doses of strychnine should be computed according to the size of the patient and the requirements of the case; it is safer to commence with the minimum dose and gradually to increase.

As strychnine is *cumulative* in its action, the effects, especially in dogs, should be carefully watched.

INCOMPATIBLES.—Alkalies and alkaline carbonates, bromides and iodides.

The *Liquor Strychninæ* should not be prescribed with iodide of potassium, as an insoluble iodide may be precipitated. It is not safe to dispense *Liquor Strychninæ* with alkaline solutions, as the alkaloid may become precipitated from the mixture.

Syrupus Ferri Phosphatis cum Quinina et Strychnina (Syr. Ferr. Phosph. c. Quinin. et Strych.).—Syrup of Phosphate of Iron with Quinine and Strychnine; Easton's Syrup.

10 ml. contain 0.18 g. anhydrous ferrous phosphate, 0.148 g. quinine sulphate, and 0.003 g. strychnine hydrochloride; or 1 fl. dr. contains 1 gr., $\frac{1}{4}$ gr., and $\frac{1}{80}$ gr. of the respective ingredients.

Dose.—For dogs, \mathfrak{M} v. to \mathfrak{M} xxx.

Great care is necessary in prescribing this preparation for dogs, in consequence of the large quantity of strychnine which it contains, and the marked susceptibility of the dog to its toxic actions.

ACTIONS OF STRYCHNINE AND NUX VOMICA.

In medicinal doses strychnine and nux vomica act as vegetable bitters (*q.v.*), reflexly augmenting the secretion of gastric juice, improving the appetite, and assisting digestion.

When strychnine enters the blood, its specific action is exerted on the medulla and the spinal cord.

The Cerebrum.—Strychnine has comparatively little effect on the cerebrum.

The Medulla.—Strychnine stimulates the respiratory centre, so that the movements of respiration are rendered quicker and deeper. It stimulates the vasomotor centre and raises blood-pressure. The vagal centre is also stimulated, and this, with the rise in blood pressure, slows the heart.

The Spinal Cord.—Strychnine in large doses markedly increases the conductivity of the cord, and powerful convulsions of a reflex nature are easily provoked by slight afferent impulses. After the administration of toxic doses, the slightest sound or touch is therefore sufficient to throw most of the voluntary muscles into a state of intense contraction.

Both extensor and flexor muscles are affected, but since the extensors are the more powerful, a condition of general extensor spasm of the trunk and limbs results. The muscular contractions are maintained for a period of ten to sixty seconds, after which relaxation occurs.

While the convulsions are of spinal origin, they are reflex in character, and their production primarily depends upon the reception of external stimuli.

Respiration.—As already stated, the respiratory centre is stimulated, and the respirations are rendered deeper and more frequent. *Toxic doses* may arrest respiration by causing violent contraction of the diaphragm and other respiratory muscles during a convulsion, and after a very large dose of the drug this effect may be rapidly produced. Toxic doses also paralyse the respiratory centre.

The Circulation.—Strychnine has no direct action on the heart. As already stated, the heart is slowed and blood pressure raised by central action.

Plain Muscle.—Strychnine increases the tone of plain muscle. This action is probably due to its increasing reflex excitability. The movements of the stomach are unaffected by strychnine, but it is believed that intestinal peristalsis is increased.

Excretion.—Strychnine is eliminated very slowly from the body, and chiefly by the kidneys; it may be found in the urine up to eight days after the last dose has been administered. Strychnine is a cumulative poison, and its cumulative action is believed to depend upon its contracting the renal capillaries and so hindering its own excretion.

TOXIC ACTIONS.—Strychnine poisoning is very frequently met with in canine practice. Many fatalities in dogs have been due to accidental poisoning and to the malicious use of strychnine, since it is a favourite constituent of rat-pastes and vermin-killers, and is still employed to 'poison' lands for the purpose of preventing the trespass of dogs. When administered for

medicinal purposes, toxic symptoms are sometimes observed, depending either upon an excessive dose of the drug, its cumulative action, or special susceptibility on the part of the patient.

No tolerance is acquired to the action of strychnine.

The toxic dose for the dog is stated to be from $\frac{1}{4}$ to $\frac{1}{2}$ grain, but much smaller amounts may produce toxic symptoms, especially in small animals. One thirty-second of a grain has produced toxic symptoms in a fox terrier.

The symptoms in the dog vary in severity according to the amount of the drug taken. A large dose may cause death after two or three convulsions, as respiration becomes arrested by violent contraction of the diaphragm and other respiratory muscles. A smaller dose produces shorter convulsions with longer intervals of quiescence. Death results from asphyxia due to paralysis of the respiratory centre.

In consequence of the extensor muscles being more powerful than the flexors, the head is drawn backwards, the fore and hind limbs are extended, and the trunk is bent backwards (opisthotonos). The convulsions resemble those occurring in tetanus, but differ from these in that they alternate with periods of complete relaxation. In the convulsions of strychnine-poisoning, the tonic contractions of the muscles are succeeded by irregular clonic contractions, and then by a period of relaxation, after which the convulsions recur. Consciousness is unimpaired throughout.

For the horse, from 3 to 6 grains given hypodermically have proved toxic. The symptoms observed are laboured respiration, accelerated pulse, abdominal pain, excitement, and violent tetanic spasms when the surface of the body is touched.

Individual cattle present an idiosyncrasy in their susceptibility to the toxic action of strychnine. Hypodermic injections of 1 grain of strychnine hydrochloride have produced toxic symptoms in milch cows, and cases have been recorded in which this dose has caused death.

Post-Mortem Appearances.—The *post-mortem* appearances are those of asphyxia.

ANTIDOTES.—In the dog, if the case be seen shortly after the ingestion of the poison, an emetic, preferably apomorphine, should be administered at once, but if convulsions be in evidence emetics are of little value; indeed, during a convulsion the vomited material may enter the trachea. Because of the difficulty of administering antidotes by the mouth, rectal injection may be employed; large doses of chloral hydrate (grs. xx. to 3i.) in a menstruum of thick treacle water with potassium bromide (3i. to 3iii.) should be given in this way. Morphine

may be injected hypodermically. If necessary, the antidotes are repeated at intervals of fifteen to thirty minutes, and *their administration is continued until the toxic symptoms have been overcome.*

The intravenous injection of nembutal (see p. 202) in a dose not exceeding 1 grain for each pound of body weight relieves the spasms of strychnine poisoning. The injection of the drug should be stopped as soon as a sufficient degree of relaxation is effected; administration may be repeated if necessary.

The inhalation of chloroform to produce light anæsthesia tends to combat the convulsions. In cases of emergency, infusions of tobacco may be administered (see p. 254).

MEDICINAL USES.—As a bitter stomachic, *nux vomica* is prescribed in dyspepsia; it may be combined with sodium bicarbonate and other bitters, such as gentian or calumba.

As a general tonic, *nux vomica* is prescribed in debility and convalescence.

As a stimulant to the spinal cord and as a tonic to plain muscle, strychnine is prescribed in paraplegia and in atony of the bladder and intestines. It is not of benefit when definite organic lesions of the cord are present. In the paraplegia depending on chronic pachymeningitis, which is so frequently met with in canine practice, strychnine is sometimes employed, but for this purpose it is of doubtful value. The drug is *contra-indicated* in the early stages of such affections as paralysis dependent upon an inflammatory process, or in conditions in which nervous irritability is present.

In colic in the horse depending on fæcal obstruction in the intestines, *nux vomica* combined with ammonium carbonate in full doses is advised (see p. 120), but there is reason to doubt whether strychnine markedly increases the tonus of intestinal muscle, and the increased peristalsis which is induced by this treatment possibly depends upon the action of the ammonium carbonate alone.

As a circulatory stimulant and tonic, strychnine is employed in pneumonia when cardiac failure is threatened, but, as has been stated, strychnine has no direct action on the heart, and such beneficial effects as may follow its use in pneumonia probably result from the stimulation of the respiratory centre. In respiratory affections associated with depression of the respiratory centre strychnine is indicated.

It was at one time believed that the hypodermic injection of strychnine was of marked value in the treatment of surgical shock, but experiments showed that, although in lesser degrees of shock it temporarily raised the blood-pressure and caused a

marked although transient improvement, in severe cases it proved not only useless, but harmful, since, by facilitating spinal reflexes, it favours the transmission of violent stimuli to the vital centres, and so tends to increase the effects of shock.

In cattle practice, nux vomica and strychnine are largely employed. In affections of the stomach accompanied by an atonic condition of the gastric walls, full doses of nux vomica combined with ammonium carbonate are beneficial, but, as has been indicated, this effect may be due to the action of the carbonate of ammonium alone.

In that condition of paraplegia of obscure origin met with both before and after parturition in cows, the hypodermic use of strychnine is indicated after delivery has been effected. The drug should be carefully increased until slight twitching of the muscles is induced.

Strychnine was at one time employed in severe cases of milk fever, but it is now recognized that in this condition calcium therapy effects a rapid and complete curative response.

In consequence of the susceptibility of the dog to the action of strychnine, care is necessary in prescribing it, especially for the smaller breeds. The cumulative action of the drug should be remembered when it is desirable to continue its administration for some time.

Strychnine is the antidote to chloral hydrate poisoning.

BRUCINE, while resembling strychnine in its actions, is much less powerful and is not used medicinally.

Caffeine.

Caffeina (Caffein).—Caffeine; Theine; $C_8H_{10}(CH_3)_2N_4O_2 \cdot H_2O$. An alkaloid obtained from the dried leaves of *Camellia thea*, the tea plant (N.O. Ternströmiaceæ), or from other plants.

Characters.—Colourless, silky, acicular, inodorous crystals. *Solubility.*—1 in 80 of water, the solution faintly bitter, and neutral; more soluble in alcohol 90 per cent., readily in chloroform, sparingly in ether. Treated with a crystal of $KClO_3$ and HCl, the mixture evaporated to dryness in a porcelain dish, a reddish residue results, becoming purple when moistened with NH_4OH . In aqueous solution, tannic acid gives a white precipitate, white precipitate, soluble in excess; but no precipitate is caused by solution of potassio-mercuric iodide (distinction from other official alkaloids).

Tea contains about 3.3 per cent. of caffeine, with tannic acid, volatile oil, etc.; coffee, about 1.3, with volatile oil, sugar, tannic acid, etc.; maté, 1.2; guarana, 4.5 per cent. Caffeine is allied to theobromine, $C_8H_{10}(CH_3)_2N_4O_2$, dimethyl-xanthine, being, in fact, trimethyl-xanthine, which can be made synthetically. *Incompatibles.*—Tannic acid, potassium iodide and salts of mercury.

Doses.—Horses, grs. xv. to ʒi.; dogs, gr. i. to grs. iv.

Caffeina et Sodii Benzoas (Caffein. et Sod. Benz.).—Caffeine and Sodium Benzoate. A mixture of caffeine and sodium benzoate.

Source.—May be prepared by mixing caffeine with an equal weight of sodium benzoate, moistening with either water or alcohol, and drying.

Characters.—A white powder, odourless, slightly bitter taste. *Solubility*.—Soluble in about 1 part of warm water, a portion of the caffeine separating out when the solution is allowed to cool; completely soluble in 4 parts of water.

Doses.—*Hypodermically*.—Horses, grs. vii. to grs. xv.; dogs, gr. ss. to grs. ii.

Caffeinæ Citras.—Caffeine Citrate (*not official*); $C_8H_{10}N_4O_2 \cdot C_6H_8O_7$. An unstable compound of caffeine and citric acid.

Source.—By moistening citric acid and caffeine with water and drying on a water-bath, stirring constantly.

Characters.—A white, inodorous powder, with an acid, faintly bitter taste; reaction acid. *Solubility*.—1 in 4 of hot water, but on dilution yields a white precipitate of caffeine, redissolving completely in 32 of water.

Doses.—Horses, ʒss. to ʒii. (*hypodermically* grs. vii. to grs. xv.); dogs, grs. ii. to grs. viii. (*hypodermically* gr. ss. to grs. ii.).

ACTIONS.—Caffeine is a powerful stimulant to the central nervous system, especially the cerebral centres and the vital centres of the medulla. In toxic doses the spinal cord is involved, and the resultant tetanic spasms somewhat resemble those of strychnine-poisoning.

As a result of the medullary stimulation, blood-pressure rises and the respirations are increased in number and depth.

Caffeine exerts a complex action on the heart and circulation. Medicinal doses increase the rate of the heart by a direct action on the cardiac muscle; the force of contraction is slightly augmented, and the output of blood per minute is increased.

Toxic doses cause arrhythmia, terminating in fibrillary contraction of the auricles, and finally of the ventricles.

Caffeine produces dilatation of peripheral vessels by direct action on the muscular coat of the vessel wall. Nevertheless, blood-pressure is raised, as the increased output from the heart and the stimulation of the vasomotor centre overcome the effects of the peripheral dilatation.

Caffeine has a special action on muscles, medicinal doses increasing their power for work. Very large doses render the muscles stiff and hard, and induce a condition resembling *rigor mortis* of the muscle fibres; but paralysis of the respiratory centre usually occurs before this phenomenon appears.

Caffeine acts as a diuretic; as the fluid portion of the urine is much increased, the specific gravity is lowered, but the total amount of the solids excreted is also increased. There is at first a temporary constriction of the renal vessels, produced by central

stimulation, and a lessened flow of urine. Dilatation of these vessels next occurs, followed by diuresis. It is also believed that the diuresis is largely dependent on the action of caffeine in increasing the proportion of actively functioning glomeruli.

MEDICINAL USES.—Caffeine is of great value as a general nervine and cardiac stimulant, especially in asthenic febrile conditions (as equine influenza and pneumonia), and as a restorative in threatened collapse.

It is an antidote to morphine-poisoning in the dog.

Caffeine is occasionally prescribed as a diuretic in cardiac dropsy in canine practice.

Theobromine and Sodium Salicylate.

Theobromina et Sodii Salicylas (Theobrom. et Sod. Salicyl.).—Theobromine and Sodium Salicylate; Diuretin. A mixture of sodium theobromine and sodium salicylate in approximately molecular proportions.

Source.—May be obtained by combining sodium hydroxide, theobromine, and sodium salicylate in molecular proportions. Should be preserved in stoppered amber-coloured bottles.

Characters.—A white amorphous powder. No odour; taste sweetish, alkaline. **Solubility.**—1 in 1 of water; soluble in alcohol 90 per cent.; insoluble in ether and chloroform. Aqueous solution alkaline. Acidified with acetic acid gives violet colour with Fe_2Cl_6 . Contains not less than 40 per cent. of theobromine and 35 per cent. of salicylic acid.

Dose.—Dogs, grs. v. to grs. xv.

Theobromine in its diuretic action resembles caffeine, but, unlike caffeine, it does not stimulate the central nervous system. Theobromine is advantageously prescribed with digitalis in dropsy of cardiac origin in the dog.

Digitalis.

Digitalis Folium (Digit. Fol.).—Digitalis Leaves; Foxglove Leaves. The dried leaves of *Digitalis purpurea*, N.O. Scrophularinæ, collected from plants commencing to flower, thoroughly dried at a low temperature, and kept dry in well-filled air-tight containers. When powdered, no portion should be rejected.

Characters.—From 10 to 30 cm. long, sometimes 12.5 to 15 cm. broad, with a winged petiole, down which lower veins are decurrent; broadly ovate or oval lanceolate, subacute, crenate; or crenate-dentate, somewhat rugose, hairy, dull-green above, densely pubescent, paler beneath. Odour faint; taste very bitter.

Composition.—The active principle of digitalis, known as *digitalinum* or *digitalin*, occurs in two forms: (a) *Homolle* and *Quénenne's digitalin*, a yellowish-white, amorphous or scaly, intensely bitter substance; and (b) *Nativelle's digitalin*, in crystalline prisms, also very bitter. It is now known to be a compound of four glucosides—namely: (1) *Digitoxin*, $\text{C}_{34}\text{H}_{54}\text{O}_{11}$, insoluble in water, most

active and poisonous, the chief constituent of Nativelle's digitalin; (2) *digitalin*, $C_{29}H_{46}O_{12}$, insoluble in water, forms the bulk of Homolle's digitalin; (3) *digitalein*, an indefinite compound, soluble in water; (4) *digitophyllin*, $C_{32}H_{52}O_{10}$, crystalline; and *digitonin*, $C_{27}H_{46}O_{14}$, a saponin which suspends the insoluble glucosides. In the leaves, digitoxin, digitalein (or gitalin) and digitonin preponderate; in the seeds there is more digitalin and digitonin but very little digitoxin. *Incompatibles*.—Ferric salts, which give a slightly inky colour with digitalis (tannates); lead acetate; preparations of cinchona.

Digitalis Pulverata (Digit. Pulverat.).—Powdered Digitalis Leaf biologically assayed to contain 10 units of activity in 1 gm.

DOSES OF THE POWDERED LEAVES.—Horses, grs. xv. to 3ss.; pigs, grs. ii. to grs. v.; dogs, gr. $\frac{1}{4}$ to grs. ii.

Infusum Digitalis Recens (Inf. Digit. Rec.).—0.5 in 100 of boiling water.

DOSES.—Horses, 3ii. to 3iv.; dogs, 3ss. to 3ii.

Tinctura Digitalis (Tinct. Digit.).—0.1 gm. of the International Standard Digitalis Powder in 1 ml. of 70 per cent. alcohol.

DOSES.—Horses, 3ii. to 3iv.; pigs, 3x. to 3xv.; dogs, 3ii. to 3x.

Fluid extracts of digitalis, which are adjusted to a definite standard by physiological assay, are also prepared.

Various proprietary preparations of digitalis are prepared commercially.

DIGIPOTEN (*not official*) is a trituration of the glucosides of digitalis with sugar of milk. It contains the several active and medicinal glucosides of the drug, and is standardized physiologically. One grain is equivalent to 1 grain of digitalis leaves.

DIGALEN (*not official*) is an aqueous solution said to be mostly digitalein. It is supplied in the form of solution and in hypodermic tablets, but may cause irritation when injected subcutaneously.

DOSES.—Horses, 3iv.; dogs, 3v. to 3xv.; by intramuscular injection.

ACTIONS OF DIGITALIS.

Externally, digitalis has no effect on the skin, but exerts an irritant action on mucous surfaces; if injected subcutaneously it causes inflammation, which may terminate in abscess formation.

Internally, the chief actions of the drug are exerted on the heart, the bloodvessels, and the kidneys.

In full doses digitalis produces nausea in all animals, but the vomiting which is commonly associated with the repeated administration of digitalis to dogs is probably of central origin, as the drug stimulates the vomiting centre.

The Heart. Digitalis exerts a complex action. In medicinal doses the drug slows the rate of the heart. This effect is brought about in two ways: (a) By stimulation of the vagal centre in the medulla, and to some extent by stimulation of the vagal endings in the cardiac muscle; (b) by depressing the conductivity of the auricular-ventricular node (bundle of His). Digitalis also acts on the cardiac muscle, so that its tonus is increased and systole becomes more forceful.

As the result of both actions the heart-beat is slowed and the organ fills and empties itself more completely—*i.e.*, diastole and systole are more efficiently performed; and in consequence the output from the heart is augmented.

The toxic action of digitalis on the heart may be conveniently considered as occurring in two stages.

The *first* stage may be termed that of excessive inhibition. In it the inhibitory action of the drug temporarily predominates over the stimulation of the cardiac muscle. The excessive vagus stimulation further hinders normal conduction from auricle to ventricle, and results in a slow and irregular beat; there may be marked arrhythmia.

In the *second* stage the muscular irritability overcomes the action of the vagus, the heart-beats become much accelerated and irregular, and ultimately 'delirium cordis' results.

The Bloodvessels.—Vaso-constriction, both peripheral and central, occurs; but the former is considerable, and is due to a direct action of the drug on the muscular coat of the arterioles.

Blood-Pressure.—Medicinal doses of digitalis cause a rise in blood-pressure partly because of the vaso-constriction, but mainly because of the increased output from the heart. During the first stage of the toxic action there is a fall in blood-pressure because of the diminished output from the heart, while in the second stage the pressure rises temporarily during the cardiac acceleration, but falls again when marked arrhythmia sets in, and it drops to zero on the occurrence of 'delirium cordis.'

Digitalis in toxic doses causes constriction of the coronary arteries, and this may occur to such an extent that death results from interference with the blood-supply of the heart.

The Kidneys.—In the normal animal digitalis does not induce diuresis, but if the drug be given in a case of mitral disease accompanied by venous congestion, ascites, and a scanty secretion of urine, its administration is followed by free diuresis. This depends on an improved circulation, whereby the kidney receives a proper supply of arterial blood. The fluid portion of the urine is increased, but the salts and urea are not augmented proportionally.

ACTIONS AND USES.—The action of *strophanthus* on the heart is similar to that of *digitalis*, but because of its weaker action as a medullary stimulant, it causes less arterial constriction and the vomiting centre is excited to a lesser extent; it is also less irritant, and reflex vomiting is less likely to occur; the renal vessels are not constricted and it is a better diuretic. It is more rapid in its actions than *digitalis*, but *strophanthus* is, however, more rapidly broken down in the stomach and its action when given by mouth is more uncertain. It is excreted sufficiently rapidly to prevent cumulative effects.

Strophanthus is prescribed for the same purposes as *digitalis*, and may be employed when *digitalis* is found to disagree with the patient.

Strophanthin is occasionally prescribed as a heart tonic.

Squill.

Scilla (Scill.).—Squill. The bulb of *Urginea scilla*, N.O. Liliaceæ; divested of its dry membranous outer scales, cut into slices, and dried; when powdered should be kept dry over quicklime.

Characters.—Curved, yellowish-white, somewhat translucent strips, frequently tapering towards both ends; about 2.5 to 5 cm. long, brittle and easily pulverizable when dry, tough and flexible when moist. Almost inodorous; disagreeably bitter. *Substance resembling Scilla.*—*Tragacanth*; translucent.

Composition.—Toxic amorphous glucosides, *scillipicrin* and *scillitoxin*; with *scillin*, an inactive glucoside; carbohydrate and mucilage.

Acetum Scillæ (Acet. Scill.).—Vinegar of Squill; Squill, 10; Dilute Acetic Acid, 100.

Doses.—Horses, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{ss}$.; dogs, $\mathfrak{M}\text{v}$. to $\mathfrak{M}\text{xv}$.

Syrupus Scillæ (Syr. Scill.).—Vinegar of Squill, 45; Refined Sugar, 80; Water to 100.

Doses.—Horses, $\mathfrak{z}\text{ss}$. to $\mathfrak{z}\text{i}$.; dogs, $\mathfrak{M}\text{x}$. to $\mathfrak{M}\text{xxx}$.

Tinctura Scillæ (Tinct. Scill.).—Squill, 10 in 100 of Alcohol 60 per cent.; by maceration.

Doses.—Horses, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{i}$.; pigs, $\mathfrak{M}\text{x}$. to $\mathfrak{M}\text{xv}$.; dogs, $\mathfrak{M}\text{ii}$. to $\mathfrak{M}\text{xv}$.

ACTIONS.—Squill very closely resembles *digitalis* in its actions. Small doses cause a mild irritation of the stomach, and reflexly produce secretion from the bronchioles; hence squill is an expectorant. It is also believed that this effect is partly a remote local one—i.e., the bronchial glands are stimulated during the excretion of the drug.

Squill is markedly diuretic, acting thus not only in virtue of its action on the circulation (see *Digitalis*), but because of its direct action on the kidneys.

Large doses in the dog cause vomiting, purging, and urinary irritation.

MEDICINAL USES.—Squill is chiefly used in the treatment of chronic bronchitis in the dog, when increase of the bronchial secretion is indicated; its action on the heart may also be of benefit in this condition. Squill is occasionally prescribed in the treatment of dropsy of cardiac origin, and for this purpose may be combined with small doses of digitalis and calomel.

It is *contra-indicated* in the early stages of acute bronchitis and in acute nephritis.

Convallaria.

Convallaria (not official).—The flowers as well as the entire plant of *Convallaria majalis* (lily of the valley). Active principle is *convallamarin*, a glucoside.

Tinctura Convallariæ (B.P.C.)—Tincture of Convallaria.

One part of convallaria in 8 parts of alcohol (60 per cent.).

DOSES.—Dogs, ℥i. to ℥x.

ACTIONS AND USES.—Convallaria very closely resembles digitalis in its actions. It does not possess the nauseating effects of digitalis, and is not cumulative. It is occasionally prescribed in veterinary practice as a cardiac tonic and diuretic.

Ergot.

Ergota (Ergot.).—Ergot; Ergot of Rye. The sclerotium of *Claviceps purpurea*, N.O. Pyrenomycetes, originating in the ovary of *Secale cereale*, the rye. Ergot should be thoroughly dried and kept entire in air-tight containers; it should not be used if more than one year old. Required to yield not less than 0.05 per cent. of total alkaloids.

Characters.—Subcylindrical, tapering, curved; 1.5 to 4 cm. long; longitudinally furrowed on each side, especially the concave; cracked; very dark violet-black without, pinkish-white within; fracture short. Odour peculiar, disagreeable, especially if triturated with solution of sodium hydroxide; taste disagreeable.

Composition.—Ergot contains the following important bodies: (1) *Ergometrine*, $C_{19}H_{23}O_2N_3$, a crystalline alkaloid causing powerful rhythmic uterine contractions; (2) *Ergotoxine*, $C_{35}H_{41}N_5O_6$, an amorphous alkaloid, which causes gangrene and uterine contractions; (3) *ergotonine*, $C_{35}H_{39}N_5O_5$, an inert alkaloid; (4) *ergotamine*, *p*-hydroxy-phenyl-ethylamine, or 'tyramine,' $OH.C_6H_4.CH_2CH_2NH_2$, related to and having an action like adrenaline; (5) *ergamine*, *histamine*, or β -iminazoyl-ethylamine, $C_5H_9O_3$, which possesses ecboic effects; (6) *ergothioneine*, $C_9H_{15}N_3O_2S_2H_2O$. There is 30 per cent. of fixed oil and colouring matters. Sphacelinic acid, cornutine, and ergotinic acid are impurities.

Another alkaloid also named *ergotamine* ($C_{33}H_{35}O_5N_5$) is found in ergot from sources other than rye has an action pharmacologically identical with that of ergotoxine.

Ergota Præparata (Ergot. Præp.).—Prepared Ergot. This is ergot powdered and immediately deprived of its fat. It contains 0.1 per cent. of the total alkaloids of ergot, calculated as ergotoxine.

Doses.—Horses and cattle, $\frac{3}{8}$ ss. to $\frac{3}{4}$ i.; sheep and pigs, $\frac{3}{4}$ i. to $\frac{3}{4}$ ss.; dogs, grs. xv. to grs. xx.

Extractum Ergotæ Liquidum (Ext. Ergot. Liq.).—Aqueous, with Alcohol 90 per cent. added. Standardized to contain 0.06 per cent. total alkaloids.

Doses.—Horses and cattle, $\frac{3}{4}$ i. to $\frac{3}{4}$ ii.; sheep and pigs, $\frac{3}{4}$ x. to $\frac{3}{4}$ xxx.; dogs, $\frac{3}{4}$ v. to $\frac{3}{4}$ xx.

Ergometrina (Ergomet.).—Ergometrine.

Characters.—Colourless crystals which become coloured on exposure to air or light; odourless; slightly bitter taste; slightly soluble in water.

Doses.—By intramuscular injection. Horses, gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$; dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$.

Ergotoxinæ Æthanosulphonas (Ergotox. Æthanosulph).—Ergotoxine Ethanesulphonate.

Characters.—Colourless, acicular crystals; odourless; sparingly soluble in water.

Doses.—Horses and Cattle, grs. $\frac{1}{8}$ to grs. $\frac{1}{4}$. Dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$.

Extractum Ergotæ.—Extract of Ergot (*not official*). Made by macerating ergot with water; straining, evaporating; adding alcohol 90 per cent. and evaporating to soft extract.

Doses.—Horses and cattle, $\frac{3}{8}$ ss. to $\frac{3}{4}$ ii.; sheep and pigs, grs. xv. to grs. xx.; dogs, grs. ii. to grs. viii. (gr. $\frac{1}{16}$ to gr. $\frac{1}{4}$ per pound body-weight for oral administration [Gray]).

Tinctura Ergotæ Ammoniata (*not official*).—Ergot, 25; Solution of Ammonia, 10; Alcohol 60 per cent. to 100; by percolation.

Doses.—Horses and cattle, $\frac{3}{4}$ i. to $\frac{3}{4}$ ss.; dogs, $\frac{3}{4}$ xv. to $\frac{3}{4}$ xl.

A number of standardized preparations of ergot now occur in commerce.

ACTIONS.—The actions of ergot depend on the presence of the active constituents—viz., *Ergometrine*, *Ergotoxine*, *Ergotamine*, *Tyramine*, and *Histamine*.

ERGOMETRINE produces its most important action on the uterus, upon which its effects are prompt and powerful, when given either by mouth or by parenteral injection. It is particularly distinguished from the other alkaloids of ergot by the promptness of its action. While it stimulates the sympathetics, causing an increased blood-pressure, it does not subsequently paralyse them, so there is no resultant fall in blood-pressure.

ERGOTOXINE, by primarily stimulating the myoneural junctions of the motor fibres of the sympathetic, powerfully contracts the arterioles and capillaries, and raises blood-pressure; it later paralyses the motor nerve-endings of the sympathetic, so that blood-pressure falls. While the motor actions of adrenaline are antagonized by ergotoxine, the inhibitor actions remain unaffected.

Ergotoxine increases the tonus of the gravid uterus to a marked extent. This action is chiefly evidenced at full term. The uterine stimulation is slow in its development, but is prolonged. If there exist a mechanical impediment to delivery, the rhythmic contractions become spastic in character and uterine rupture may even result. The action of ergotoxine can be produced by oral administration as well as by hypodermic injection. Occasionally the heart is slowed, due to the raised blood-pressure increasing the tonus of the vagus centre.

TYRAMINE stimulates the sympathetic myoneural junctions (both motor and inhibitory), and resembles adrenaline in this respect. It thus causes a quicker and more vigorous cardiac beat, and a rise in blood-pressure from vaso-constriction. It induces rhythmic contractions in the gravid uterus. It is suggested that since the sympathetic supplies both motor and inhibitory nerves to the uterus, when the organ hypertrophies during pregnancy the development of the motor sympathetic fibres is markedly increased compared with that of the inhibitory; hence tyramine elicits its action on the gravid uterus, while in the non-pregnant state its effect is insignificant. Tyramine decreases tonus of intestinal muscle and inhibits peristalsis.

HISTAMINE exerts a direct stimulant action on plain muscle, increasing its tonus. It acts specially on the uterus, and its effect is as marked in the non-pregnant as in the gravid condition. It also markedly stimulates the bronchial and intestinal muscle.

Histamine contracts arterioles, but causes marked dilatation of the capillaries and fall in blood-pressure.

ACTIONS OF ERGOT.—A consideration of the actions of the active constituents indicates the effects produced by administration of ergot itself. Ergot causes constriction of the arterioles and capillaries, this effect depending on the action of ergotoxine and of tyramine on the myoneural junctions. The vaso-dilatation induced by histamine is overcome by the other constituents of ergot.

The Heart and Blood Pressure.—While ergotoxine and tyramine stimulate the sympathetic accelerator mechanism, the rise in blood-pressure which these also induce slows the heart-rate.

Uterus.—As has been indicated, ergot induces rhythmic contractions of the uterus.

TOXIC EFFECTS.—Comparatively large doses of ergot can be administered to non-pregnant animals without ill-effect. Russell Greig and Wilson gave 2 pounds of the freshly powdered sclerotia, the active potency of which was determined by physiological assay, to a horse over a period of four days without producing symptoms

of observable illness. But when ergot is administered for a prolonged period, or when ergotized grasses are browsed by stock, the cumulative toxic effects of the drug are elicited—*ergotism*. This is evidenced by dry gangrene and sloughing of the extremities due to chronic capillary constriction. Pregnant animals may abort. There are also observed nervous phenomena, consisting in convulsive twitchings, spasms, convulsions, and finally paralysis.

ANTIDOTES.—It is of first importance to determine and withhold the infected food. Further treatment is symptomatic.

MEDICINAL USES.—Ergot is principally used in veterinary practice in the treatment of uterine inertia. This condition is rare in the larger animals, but common in canine practice, especially in small bitches. Before employing the drug in such cases it must be ascertained that no obstruction to delivery, such as results from malposition of the foetus, is present. Moderate doses should be prescribed, in order to avoid spastic contractions of the uterus, such as might cause the death of the foetus by constriction of the uterine blood-vessels, or might induce rupture of the organ.

In post-partum hæmorrhage ergot proves useful, by promoting contraction of the uterus, and to a lesser extent by causing constriction of the uterine bloodvessels. This condition is of comparatively rare occurrence in veterinary practice.

In the treatment of internal hæmorrhage ergot is prescribed, but, as it raises the general blood-pressure, it may prove more harmful than beneficial and should not be employed for this purpose.

In combination with such drugs as veratrine and strychnine, ergot is employed as a palliative of the acute respiratory symptoms associated with pulmonary emphysema in the horse. It enters into the composition of several proprietary preparations for this purpose, and any beneficial effect it may possess may be ascribed to its action on the muscular walls of the bronchioles and alveoli.

In retention of the placenta in the mare and cow powdered ergot is often prescribed, and forms a constituent of 'cleansing draughts'; but unless it be freshly prepared, powdered ergot is frequently inactive, and is notoriously unreliable as an ecbolic.

In consequence of the tendency of preparations of ergot to cause local irritation when administered hypodermically, intramuscular injection is preferable.

BITTERS.

Bitters stimulate the gustatory nerves in the mouth, and reflexly excite the flow of gastric juice. Large doses arrest gastric secretion, and if bitters be repeatedly administered for a prolonged period, chronic dyspepsia and gastric catarrh may result.

Bitters may be classified as:

- (1) *Simple Bitters* with a purely bitter taste, and
- (2) *Aromatic Bitters*, which combine a bitter taste with an aromatic flavour.

SIMPLE BITTERS.

Calumba (Calumb.).—*Calumba* Root. The dried transversely-cut slices of the root of *Jateorhiza columba*, N.O. Menispermaceæ.

Characters.—Flattish, circular or oval slices, depressed centrally, 2.5 to 5 cm. broad, from 3 to 12 mm. thick. Cork brownish, wrinkled; the cortex thick, yellowish, separated by a dark line from greyish wood; fracture short. Odour feeble; taste bitter.

Composition.—*Calumba* contains three yellow crystalline alkaloids: *Jateorhizine*, $C_{20}H_{29}NO_5.OH$, *Columbamine*, $C_{21}H_{22}NO_5.OH$, and *Palmatine*, $C_{21}H_{22}NO_6.OH$; a colourless, bitter, crystalline principle, *Columbin*; 35 per cent. of starch; but no tannic acid.

Tinctura Calumbæ (Tinct. Calumb.).—10 in 100 of Alcohol 60 per cent.; by maceration.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ii.; sheep and pigs, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, \mathfrak{z} ss. to \mathfrak{z} i.

ACTIONS AND USES.—*Calumba* is a bitter stomachic. It is prescribed in atonic dyspepsia, and is commonly combined with *nux vomica* and an alkali such as sodium bicarbonate.

Quassia (Quass.).—*Quassia* Wood. The wood of the trunk and branches of *Picræna excelsa*, N.O. Simarubææ.

Characters.—Logs, chips or raspings; yellowish-white, dense, tough. Inodorous; taste intensely bitter.

Composition.—*Quassia* contains *quassin*, a mixture of two white, crystalline, neutral bitter principles, α -*picrasmin*, $C_{35}H_{46}O_{10}$, and β -*picrasmin*, $C_{24}H_{48}O_{10}$. It contains no tannic acid.

Infusum Quassiæ Concentratum (Infus. Quass. Conc.).—8 per cent. in Alcohol and Water.

Infusum Quassiæ Recens (Infus. Quass. Rec.).—1 in 100 of cold Water.

Tinctura Quassiæ (Tinct. Quass.).—In Alcohol 45 per cent.; by maceration.

Doses.—Horses and cattle, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, \mathfrak{z} ss. to \mathfrak{z} i.

ACTIONS AND USES.—*Quassia* resembles in its actions gentian and *calumba*. As a bitter tonic, it has uses similar to those of *calumba*. In the form of the concentrated infusion it is employed as an enema to destroy oxyures in the rectum of the horse.

The infusions form valuable parasiticide washes in pediculosis in dogs.

The concentrated infusion combined with glycerin, if applied to the skin of animals at pasture, prevents irritation from flies.

AROMATIC BITTERS.

Gentiana (Gentian.)—*Gentianæ Radix*.—Gentian Root. The dried rhizome and root of *Gentiana lutea*, N.O. Gentianeæ.

Characters.—Nearly cylindrical, entire or longitudinally split, varying in length, seldom exceeding 2.5 cm. in thickness, yellowish-brown, longitudinally wrinkled; bearing closely approximated encircling leaf-scars; frequently terminated by a bud. Tough when slightly moist; brittle if dry. Fracture reddish-yellow. Odour characteristic; taste at first slightly sweet, afterwards bitter.

Composition.—Gentian contains 0.1 per cent. of a bitter glucoside, *gentiopicrin*, $C_{20}H_{30}O_{12}$, crystalline (present in the fresh drug but decomposed on drying), yielding glucose and *gentiogenin*; and the glucosides *gentiin* and *gentiamarin*; also *gentianic acid*, sugar, gum, and a trace of a volatile oil; but no starch. *Incompatibles.*—Iron sulphate, silver nitrate, and lead salts.

DOSES OF POWDERED GENTIAN ROOT.—Horses, ʒss. to ʒi.; cattle, ʒi. to ʒii.; sheep and pigs, ʒi. to ʒii.; dogs, grs. v. to grs. xx.

Extractum Gentianæ (Ext. Gent.).—Soft extract; by aqueous infusion.

Dose.—Dogs, grs. ii. to grs. x.

Tinctura Gentianæ Composita (Tinct. Gent. Co.).—Gentian, 10; Dried Bitter Orange Peel; Cardamom Seeds; Alcohol 45 per cent. to 100. By maceration.

Doses.—Horses and cattle, ʒi. to ʒii.; dogs, ʒss. to ʒi.

A fluid extract six times the strength of the official tincture is a commercial preparation.

ACTIONS AND USES.—Gentian is a bitter tonic and stomachic, possessing but slight astringent actions. It is the vegetable bitter most commonly employed in veterinary practice. The addition of powdered gentian to aloes is said to increase its purgative action.

Aurantii Cortex Recens (Aurant. Cort. Rec.).—Fresh Bitter Orange Peel. The fresh outer part of the pericarp of *Citrus aurantium*, var. *bigaradia*, N.O. Rutaceæ.

Characters.—Deep orange red or red; rough and glandular; only a very small part of white spongy portion of pericarp internally; odour aromatic, pleasant; taste aromatic, bitter.

Tinctura Aurantii (Tinct. Aurant.).—25 in 100 of Alcohol 90 per cent.; macerate.

Doses.—Dogs, ʒx. to ʒxx.

Syrupus Aurantii (Syr. Aurant.).—Tincture of Orange, 12.5; Syrup to 100.

Doses.—Dogs, ʒx. to ʒxl.

ACTIONS AND USES.—The tincture of orange is used as a bitter stomachic for the dog. Syrup of orange is sometimes employed in canine practice as a flavouring agent for mixtures, especially those containing agents having a nauseous or bitter taste. Simple syrup is, however, preferable, as dogs as a rule dislike flavouring agents of any kind.

There are several bitters which resemble the above agents in their actions, but they are seldom employed. These include *TARAXICUM* (simple bitter), *CHIRETTA*, *CASCARILLA*, *SERPENTARY*, (aromatic bitters).

AROMATIC VOLATILE OILS.

This group comprises a large number of agents of a strongly odorous character obtained commonly from the fruits and flowering parts of certain plants. They must be distinguished from the fatty or fixed oils which are non-volatile.

The composition of the volatile oils is very variable, but the commonest constituents are terpenes, which are aromatic hydrocarbons having the general formula $(C_5H_8)_n$. The fluid portion of the oil in which the terpenes are contained is termed *ELÆOPTENE*. Many volatile oils also contain oxidized hydrocarbons named *STEAROPTENES*, which crystallize out when the oil is subjected to low temperature or upon long standing.

Volatile oils are almost insoluble in water, but the solutions possess their characteristic odour. They are feebly soluble in fixed oils and in alcohol, chloroform, and ether.

Externally, volatile oils are antiseptics and parasitocides. They are stimulant to the skin, and some are employed as counter-irritants. In the case of others (oil of cloves) the primary stimulation is succeeded by anæsthesia.

Medicinally, they all possess antiseptic properties, and by relaxing spasm of the intestinal muscle and reducing excessive movements of the bowel they are carminative and antispasmodic. Volatile oils prevent the tendency to griping associated with the action of purgatives, and are thus correctives. Several possess powerful anthelmintic action. The majority, during their excretion by the kidneys and the bronchial mucous membrane, act as mild local irritants, and are thus diuretics and expectorants. During excretion they also exert their antiseptic action on the respiratory and urino-genital passages.

Oleum Caryophylli (Ol. Caryoph.).—Oil of Cloves (by distillation).

Characters.—Colourless or pale yellow when recent, darkening with age; with the odour and taste of cloves. Sp. gr. 1.047 to 1.065;

heavier than water. Contains not less than 85 per cent. of eugenol. *Incompatibles*.—Lime-water, salts of iron, mineral acids, and gelatin.

Composition.—Oil of cloves consists of *eugenol* (eugenic acid), $C_{10}H_{12}O_2$; a terpene, *caryophyllene*, $C_{15}H_{24}$; *furfural*, which darkens with age; and *aceteugenol*.

Infusum Caryophylli Recens (Inf. Caryoph. Rec.).—Infusion of Cloves ($2\frac{1}{2}$ per cent.).

Dose.—Dog, \mathfrak{z} ii. to \mathfrak{z} ss.

ACTIONS AND USES.—Oil of cloves is sometimes employed in combination with cocaine as a local anæsthetic, being painted on the skin prior to the operation of 'firing.' It has been recommended as an antiseptic application in traumatic arthritis, but its value is doubtful.

The infusion is prescribed in combination with dilute sulphuric acid and decoction of logwood in the treatment of diarrhœa in the dog.

Oleum Menthæ Piperitæ (Ol. Ment. Pip.).—Oil of Peppermint. The oil distilled from fresh flowering peppermint, *Mentha piperita*, N.O. Labiata; rectified by distillation, if necessary.

Characters.—Colourless, pale yellow or greenish-yellow; odour characteristic; taste pungent and aromatic, followed by a sensation of cold. Sp. gr. 0.900 to 0.920. *Solubility*.—1 in 4 of alcohol 70 per cent.

Composition.—Not less than 46 per cent. of alcohols as *menthol*, $C_{10}H_{19}OH$, and 4.5-9 per cent. of esters as *menthyl acetate*, $C_{10}H_{19}C_2H_3O_2$; with *menthone*, *cineol*, *pinene*, *limonene*, etc.

Doses.—Horses, \mathfrak{M} xx. to \mathfrak{z} i.; dogs, \mathfrak{M} ss. to \mathfrak{M} iii.

Aqua Menthæ Piperitæ Concentrata (Aq. Ment. Pip. Conc.).—Strong Peppermint Water. Oil of Peppermint, 2; Alcohol (90 per cent.), 60; Distilled Water to 100.

Dose.—Dog, \mathfrak{M} ii. to \mathfrak{M} x.

Aqua Menthæ Piperitæ Destillata (Aq. Ment. Pip. Dest.).—Peppermint Water—1 in 1,500, by distillation.

Spiritus Menthæ Piperitæ (Sp. Ment. Pip.).—10 in 100 of Alcohol 90 per cent.

Menthol (Menthol).—Menthol. Menthol is a saturated cyclic alcohol obtained from the volatile oils of various species of *Mentha*.

Characters.—Colourless, acicular or prismatic crystals; penetrating odour resembling peppermint; taste warm and aromatic, followed by a sensation of cold.

ACTIONS AND USES.—*Externally*.—Menthol is peculiar in causing a sensation of coldness which is believed to be due to a specific stimulation of the nerve-endings conveying impressions of cold; it also acts as a local anæsthetic by paralysing the terminations of sensory nerves in the part to which it is applied.

Internally.—Oil of peppermint is employed in the treatment of spasmodic colic in the horse because of its antispasmodic and carminative actions. It relieves pain by depressing the terminations of the intestinal sensory nerves, and also relaxes intestinal spasm. As a corrective it may be combined with purgative agents.

PEPPERMINT WATER is employed in canine practice to disguise the taste of nauseous drugs.

Camphora (Camph.).—Camphor; $C_{10}H_{16}O$.

Source.—Obtained from *Cinnamomum camphora*, N.O. Lauraceæ; purified by sublimation.

Characters.—Colourless, transparent crystals or crystalline masses of tough consistence; also in rectangular tablets or in pulverulent masses known as 'flowers of camphor.' Sp. gr. about 0.995. M.p. $175^{\circ}C$. Odour characteristic, penetrating; taste pungent and somewhat bitter, followed by sensation of cold. Burns readily with a bright smoky flame; volatilizes even at ordinary temperatures; sublimes without residue when heated. Dextro-rotatory (synthetic camphor optically inactive). *Solubility.*—1 in about 700 of water; 1 in about 1 of alcohol 90 per cent.; 1 in 0.25 of chloroform; 1 in 4 of olive oil; very soluble in ether. Forms a liquid when triturated with chloral hydrate, menthol, phenol, or thymol, and certain other substances.

Doses.—Horses, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{iii.}$; cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; sheep and pigs, grs. xx. to grs. l.; dogs, grs. ii. to grs. x.

Hypodermically in sterile olive oil (1 in 4). Horses, grs. xx. to grs. xl.; dogs, gr. i. to grs. ii.

Linimentum Camphoræ (Lin. Camph.).—'Camphorated Oil.' Camphor, 20; Olive Oil, 80.

Linimentum Camphoræ Ammoniatum (Lin. Camph. Ammon.).—Camphor, 12.5; Oil of Lavender 0.5; Strong Solution of Ammonia, 25; Alcohol 90 per cent. to 100.

Spiritus Camphoræ (Sp. Camph.).—Camphor, 10; Alcohol 90 per cent. to 100.

Doses.—Horses, $\mathfrak{z}\text{ss.}$ to $\mathfrak{z}\text{i.}$; cattle, $\mathfrak{z}\text{ii.}$; dogs, $\mathfrak{M}\text{v.}$ to $\mathfrak{M}\text{xx.}$

Tinctura Opii Camphorata (Tinct. Opii Camph.).—Paregoric Elixir; Paregoric. Camphor, 0.3; Tincture of Opium, 5; Benzoic Acid, Oil of Anise; Alcohol 60 per cent. to 100; 0.5 mg. Morphine in 1 ml. ($\frac{3}{7}$ gr. in 1 fl. dr.).

Doses.—Horses and cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; sheep and pigs, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; dogs, $\mathfrak{z}\text{ss.}$ to $\mathfrak{z}\text{i.}$

ACTIONS—Externally.—The actions of camphor resemble those of volatile oils. If applied with friction to the skin it acts as a rubefacient, but after primary stimulation it produces sedative effects on the peripheral nerve-endings.

Internally, camphor is rapidly absorbed; it is carminative

and antispasmodic by exerting stimulant effects on the stomach and intestines.

The Nervous System.—It stimulates the cerebral cortex and medulla, and in full doses it causes giddiness and incoördination of movement.

The Circulation.—Camphor in medicinal doses by the mouth is a direct stimulant to the heart, which is also stimulated reflexly by local irritation of the gastric mucosa. Blood-pressure is raised by stimulation of the vasomotor centre. Large doses cause a slowing of the heart by direct action on the cardiac muscle, and a fall of blood-pressure by depression of the vasomotor centre.

The Respiratory System.—Camphor slows the respiratory movements. Its irritant action on the stomach produces a reflex expectorant effect. The diaphoretic action which camphor elicits in man is not observed in the lower animals.

Toxic doses cause stimulation of the higher nervous centres, followed by paralysis.

The symptoms induced are excitement, restlessness, and convulsions. In some cases, instead of excitement, a condition of stupor develops, and death results from respiratory failure.

MEDICINAL USES.—*Externally*, camphor is employed in the form of liniments in the treatment of strains and bruises.

The compound liniment of camphor is used as a mild counter-irritant.

Camphorated oil is employed in canine practice as a stimulating application to the thoracic walls and throat in respiratory affections.

Internally.—Camphor is occasionally used as a carminative and antispasmodic in flatulent colic. It has been found of value in diarrhoea. For this condition it is usually prescribed with opium in the form of the compound tincture of camphor. It is also given with opium in the treatment of enteritis. If combined with chloral hydrate, it is said to render that agent more effective as an hypnotic and anodyne.

As an expectorant, camphor is a common constituent of cough mixtures, but its taste and smell are very offensive to animals.

A subcutaneous or intramuscular injection of camphorated oil (camphor, 1 part; sterilized olive-oil, 4 parts) is employed as a reflex cardiac stimulant. Ether in the proportion of 2 parts for each part of camphor may be added with advantage. Administered in this way, camphor is particularly valuable as a stimulant and restorative; its action is largely a reflex one, arising from the local irritation produced at the site of injection.

Thymol (Thymol).—Thymol; Isopropylmetacresol; $C_8H_8.CH_3.OH$.- C_8H_7 . A crystalline substance obtained from the volatile oils of *Thymus vulgaris*, *Monarda punctata*, N.O. Labiatae; and *Carum copiticum*, N.O. Umbelliferae; purified by recrystallization from alcohol.

Characters.—Large oblique prismatic crystals; heavier than water; odour like that of thyme; taste pungent, aromatic. M.p. 50° to 51° C. Volatilized completely on a water-bath. **Solubility.**—1 in 1,500 of water; freely in alcohol 90 per cent., ether, oils, and glycerin (1 in 190).

Doses.—Horses, \mathfrak{z} iv. to \mathfrak{z} i.; calves, \mathfrak{z} ss. to \mathfrak{z} i.; dogs, grs. viii. to grs. xxx.

ACTIONS AND USES.—Thymol resembles carbolic acid in its actions, but is more powerful as an antiseptic, and is less irritant.

Externally.—Although thymol possesses very considerable antiseptic and disinfectant properties, it is seldom employed for these purposes because of its high price and very slight solubility in water. Aqueous solutions of 1 in 2,000 inhibit fungal growth in saccharine solutions—e.g., calcium gluconate. In alcoholic solution it is a local anæsthetic.

Internally.—Thymol is chiefly used in veterinary practice in the treatment of intestinal strongylosis in young horses. For this purpose it is dissolved in glycerin and alcohol, and administered in milk or mucilage, or it may be given in capsule. The drug is given daily for four or five consecutive days, and followed by a mild aperient. It is liable to irritate the mouth unless given properly diluted.

Thymol is occasionally prescribed as an anthelmintic for the dog in uncinariasis and ascaridiasis, the dose being repeated after an interval of one week.

Oleum Eucalypti (Ol. Eucalypt.).—Oil of Eucalyptus. The oil distilled from the fresh leaves of *Eucalyptus globulus*, *Eucalyptus dumosa*, and other species, N.O. Myrtaceae; and rectified.

Characters.—Colourless or pale yellow; odour aromatic, camphoraceous; taste pungent, leaving a sensation of cold. **Solubility.**—1 in 5 of alcohol 70 per cent. Sp. gr. 0.910 to 0.930.

Composition.—Contains not less than 70 per cent. of cineol (eucalyptol), $C_{10}H_{18}O$; *d*-pinene, $C_{10}H_{16}$; eudesmol, $C_{16}H_{26}O$; butyric and valerianic aldehydes; and phellandrene; the last three being obnoxious bodies.

Doses.—Horses, \mathfrak{z} i. to \mathfrak{z} iv.; dogs, \mathfrak{M} ss. to \mathfrak{M} iii.

It may be administered in the form of an emulsion or mixed with olive-oil.

Unguentum Eucalypti (not official).—Oil of Eucalyptus, 10; Hard Paraffin, 40; Soft Paraffin, white, 50.

ACTIONS AND USES.—**Externally.**—Eucalyptus ointment is employed as an antiseptic application.

Wool and gauze medicated with oil of eucalyptus are used as surgical dressings.

Internally.—Eucalyptus exerts antiseptic action, and is, in addition, an antipyretic. It is a respiratory antiseptic, and frequent inhalations of the drug may be employed in nasal catarrhal conditions, laryngitis, and bronchitis (see p. 102). It is also useful as an antizymotic, as it prevents excessive fermentation of the ingesta.

Eucalyptus is antiseptic to the urinary tract, and may be employed in cystitis.

Anisi Fructus.—Anise Fruit (*not official*). The dried ripe fruit of *Pimpinella anisum*, N.O. Umbelliferae.

Characters.—Ovoid, laterally compressed, rough from short bristly hairs, greyish-green or greyish-brown, about 5 mm. long and 2 mm. broad. Mericarps usually united, attached to the pedicel. Primary ridges pale, slender, entire; numerous vittæ in each mericarp. Odour agreeably aromatic; taste aromatic, sweet.

Composition.—It contains 1.5 to 3 per cent. of the official oil.

DOSES OF POWDERED ANISE.—Horses, ℥ss. to ℥i.; cattle, ℥i. to ℥ii.

Oleum Anisi (Ol. Anis.).—Oil of Anise. Oil distilled from anise fruit or from the fruit of the star anise, *Illicium verum*.

Characters.—Colourless or pale yellow; odour that of the fruit; taste sweet, aromatic. Congeals about 15° C., and should not liquefy below 17° C. Optical rotation -2° to +1°. Sp. gr. 0.975 to 0.990 at 20° C.

Composition.—Oil of anise contains a stearoptene, *anethol*, $C_{10}H_{12}O$, 80 per cent., melting at 21° C.; its isomer, *methyl chavicol*; a terpene, $C_{10}H_{16}$; and oxidation products.

Doses.—Horses, ℥xv. to ℥xl.; dogs, ℥ss. to ℥iii.

Spiritus Anisi (not official).—Anise Oil, 10; Alcohol 90 per cent. to 100.

ACTIONS AND USES—Externally.—Anise is employed in the form of SPIRITUS ANISI as a parasiticide dressing in pediculosis in dogs. It is highly effective for this purpose, but its employment requires care, as if rubbed into the skin alcoholic poisoning may result.

Internally.—Oil of anise has similar actions to the other aromatic volatile oils. It has a distinct expectorant action, probably exerted during the excretion of the drug by the bronchial mucous membrane.

Oil of anise is seldom prescribed internally, but is employed in pharmacy to give a pleasant odour to draughts and liniments.

The powdered anise fruit forms a frequent component of cough powders for the horse, and is also used as a flavouring agent in cattle draughts.

Other agents resembling anise in their actions, and containing aromatic volatile oils, are CARAWAY, CORIANDER, FENUGREEK, FENNEL, and DILL. They are chiefly used as flavouring agents to powders, draughts, etc., and enter largely into the composition of proprietary 'condition powders' and 'condiments.'

Zingiber (Zingib.).—Ginger. The scraped and dried rhizomes of *Zingiber officinale*, N.O. Scitamineæ.

Characters.—Flattish, irregularly branched pieces, 7 to 10 cm. long; a depressed scar at the summit of each branch; fracture short, with projecting fibres. Odour agreeable, aromatic; taste pungent.

Composition.—Ginger contains an *aromatic volatile oil*, composed of *camphene*, *phellandrene*, *zingiberene*, *cincol* and *borneol*; a yellow pungent body, *gingerol*; *resins* and *starch*.

DOSES OF POWDERED GINGER.—Horses, ʒss. to ʒi.; cattle, ʒi. to ʒii.; sheep, ʒi. to ʒii.; pigs, ʒss. to ʒi.; dogs, grs. x. to grs. xx.

Tinctura Zingiberis Fortis (Tinct. Zingib. Fort.).—Strong Tincture of Ginger. Essence of Ginger. Powdered Ginger, 50; in Alcohol (90 per cent.), to 100.

DOSES.—Horses, ʒi. to ʒii.; dogs, ℥iii. to ℥v.

Tinctura Zingiberis Mitis (Tinct. Zingib. Mitis).—Weak Tincture of Ginger. Strong Tincture of Ginger, 200; Alcohol 90 per cent., 800; by percolation.

DOSES.—Horses, ʒi. to ʒii.; dogs, ℥xx. to ʒss.

ACTIONS AND USES.—Ginger is an aromatic stimulant and a carminative. It is chiefly employed as a corrective to purgative agents, in order to prevent griping. Thus, it is combined with aloes for the horse and with magnesium sulphate for cattle. In impaction of the rumen in cattle, ginger, in combination with purgatives and *nux vomica*, is frequently prescribed.

The tincture of ginger is sometimes employed in the treatment of simple spasmodic colic in the horse.

Oleum Terebinthinae (Ol. Terebinth.).—Rectified Oil of Turpentine.

Source.—The oil distilled from the oleo-resin (turpentine) obtained from various species of *Pinus*, N.O. Coniferæ; rectified by redistillation.

Characters.—Limpid, colourless; odour characteristic; taste pungent, somewhat bitter. Sp. gr. 0.860 to 0.870. Distils between 156° and 180° C. Mixes with other volatile and fixed oils, and dissolves resins, wax, sulphur, phosphorus, and iodine.

Composition.—The oleo-resin, common turpentine, as it is formed on trees, is an impure solution of *resin* in 15 to 30 per cent. of the official *volatile oil*. The oil of turpentine, composed largely of *d*- and *l*-pinene, $C_{10}H_{16}$, readily absorbs oxygen from the air and is converted into resin. If oxidized by air while in contact with water it decomposes into terpene hydrate, hydrogen peroxide, and camphoric acid—the basis of 'Sanitas' disinfectants.

DOSES.—Horses, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{ii.}$; cattle, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; sheep, $\mathfrak{z}\text{i.}$ to $\mathfrak{z}\text{iii.}$; pigs, $\mathfrak{z}\text{ss.}$ to $\mathfrak{z}\text{ii.}$; dogs, $\mathfrak{M}\text{ii.}$ to $\mathfrak{M}\text{xx.}$; six-months-old calves, $\mathfrak{z}\text{ss.}$; six-months-old lambs, $\mathfrak{z}\text{i.}$

In order to prevent the irritating effect of the drug on the mouth and alimentary canal, it should be well shaken up with oil, milk, or mucilage, before administration.

A convenient emulsion of the drug for canine practice is prepared by rubbing up 30 grains of powder of gum acacia with 1 drachm of oil of turpentine and 1 drachm of water, and then adding gradually 1 ounce of water.

Linimentum Terebinthinæ (Lin. Terebinth.).—Rectified Turpentine, 65; Camphor, 5; Soft Soap, 7·5; Water to 100.

Linimentum Terebinthinæ Aceticum (Lin. Terebinth. Acet.).—Glacial Acetic Acid, 11; Liniment of Camphor 44·5; Turpentine to 100.

For the formula of a stimulating liniment containing oil of turpentine, which is more suitable for veterinary practice than are the official preparations, see p. 499.

ACTIONS.—*Externally*, turpentine is a rubefacient; if applied in concentrated form and if evaporation be prevented, it acts as a counter-irritant. The vesication produced is painful, and healing takes place slowly. It is also antiseptic and disinfectant.

Internally, turpentine exerts stimulant, antiseptic, carminative, anthelmintic, diuretic, expectorant, and hæmostatic actions, and is rapidly absorbed, diffused, and excreted.

In the stomach and intestines it is carminative by relaxing the muscle and diminishing peristalsis, but in larger doses it acts as a mild irritant and increases the bowel movements. By its powerful antizymotic action excessive fermentation is controlled.

Its anthelmintic action is chiefly confined to the destruction of round-worms. It has less effect on tape-worms.

The drug is excreted by the kidneys, lungs, skin, and intestines. During its excretion by the kidneys the renal vessels are dilated, owing to the irritant action of the drug. In medicinal doses it increases the secretion of urine, to which it gives an odour resembling that of violets.

During its excretion by the bronchial mucous membrane it acts as a mild irritant, bringing about a local vascular dilatation and increasing secretion. This expectorant action is also obtained by inhalation.

The hæmostatic action of turpentine depends upon contraction of the arterioles (central stimulation), and upon its power of clotting blood when applied locally to a bleeding vessel. It has, however, little or no value as a remote hæmostatic.

TOXIC ACTIONS.—Toxic doses cause primary stimulation and subsequent paralysis of the vital centres in the medulla, the actions resembling those of alcohol. Irritation of the kidneys and bladder, and in some instances strangury and hæmaturia are produced. Purgation may also occur.

ANTIDOTES.—Sulphate of magnesia and demulcents. In the dog the gastric contents should first be washed out by stomach tube. Stimulants may also be required.

USES.—*Externally*, oil of turpentine is employed as a constituent of stimulating liniments and embrocations, but if too severely applied, may cause marked irritation to the skin of the horse. It should not be used for this purpose in canine practice.

The liniment of turpentine is employed as a rubefacient application in rheumatic affections of joints and muscles, and to the skin in the region of the throat in laryngitis and pharyngitis.

For the destruction of the larvæ of *Lucilia sericata* and *Calliphora erythrocephala* in sheep, the following proves useful as a local application: 3 ounces of oil of turpentine, 1 ounce each of common salt, olive-oil, and mucilage, and 20 grains of corrosive sublimate, mixed in a quart of water.

Internally.—In acute gastric tympany and in flatulent colic, oil of turpentine is a favourite agent. It causes expulsion of the gases, and arrests fermentation. If pain be severe, the drug may be combined with chloral hydrate dissolved in water, and administered in a full dose of linseed-oil, and if necessary repeated.

In tympanites of the rumen in cattle, turpentine combined with ammonia and linseed-oil is frequently employed with success.

In dysentery in horses and cattle, small doses of oil of turpentine, combined with other antiseptics and with astringents, are prescribed.

In purpura hæmorrhagica turpentine is frequently prescribed with apparent benefit. It is usually combined with the tincture of perchloride of iron, 1 ounce of each being administered in wheat gruel and milk three times daily by stomach tube.

As a hæmostatic, in gastric and intestinal hæmorrhage, oil of turpentine is recommended, but its value is doubtful.

As an anthelmintic, oil of turpentine is effectual in ascarid infestations in the horse. For this purpose it is administered in linseed-oil. As a tænicide it is usually combined with malefern.

In canine practice the drug must be very carefully administered, as it may produce irritation of the stomach and kidneys. In properly regulated doses it is employed in combination with other anthelmintic agents in the eradication of intestinal round-

worms in the dog. The value of turpentine in the treatment of round-worm infestations in the pig and the dog is disputed; for this purpose it has now been largely displaced by other agents such as oil of chenopodium.

In the treatment of parasitic bronchitis in calves, oil of turpentine is administered by intratracheal injection, and proves an effectual remedy. Two drachms of oil of turpentine, 10 minims of liquefied carbolic acid, 1 drachm of olive-oil, 20 grains of potassium carbonate, and 1 drachm of water, are emulsified. This amount is injected into the trachea once daily for three days.

Added to boiling water, it forms a useful antiseptic and expectorant inhalation in catarrhal affections of the respiratory mucosa.

CONTRA-INDICATIONS.—Turpentine is contra-indicated in congestion of the kidneys, in nephritis, cystitis, gastritis, and enteritis.

Terebenum (Tereben.).—Terebene. A mixture of dipentene and other hydrocarbons.

Source.—Obtained by shaking oil of turpentine with successive portions of sulphuric acid until optically inactive, and then distilling in a current of steam.

Characters.—A colourless liquid. Odour agreeable; taste terebinthinate, aromatic. Sp. gr. 0.862 to 0.866. Distils between 156° and 180° C.

Doses.—Horses, ℥i. to ℥ii.; cattle, ℥ii. to ℥iv.; sheep, ℥i. to ℥iii.; pigs, ℥ss. to ℥ii.; dogs, ℥ii. to ℥xx.

ACTIONS AND USES.—*Externally*, terebene is antiseptic and parasiticide.

The combination of terebene 1 part and olive oil 10 parts may be usefully employed as an application to wounds which cannot be frequently dressed—*e.g.*, in the case of horses at grass. Creosote in the proportion of ℥ii. to O.i. may be added with advantage.

Internally.—Terebene resembles oil of turpentine in its actions, but is more diffusible and less irritating in its effects on the kidneys. It is a useful agent in the treatment of gastric tympany and flatulent colic in the horse. It is largely employed as an inhalation in nasal catarrh and bronchitis, and in the treatment of the irritable useless cough associated with bronchial irritation in the dog.

In parasitic bronchitis in calves, when intratracheal injections cannot be conveniently carried out, the administration of terebene by mouth often proves of benefit. It may be given in milk, in doses of $\frac{1}{2}$ ounce, twice daily. This treatment is also of value in bronchial catarrh in calves.

The destruction of worm parasites in the respiratory tract of cattle and sheep which follows the oral administration of terebene is probably in part due to the partial elimination of the drug by the bronchial mucosa. It is also to be remembered that respiratory worm infestations are commonly associated with abomasal and intestinal helminthiasis, and the latter conditions are directly acted upon when terebene is administered by mouth.

SANITAS (*not official*) is prepared by the oxidation of oil of turpentine; it contains hydrogen peroxide, a soluble camphor, some camphoric acid, and thymol. *Sanitas* fluid forms a volatile, oxidizing, non-poisonous disinfectant and deodorant; it is employed to disinfect and deodorize stables and kennels. *Sanitas* powder and *Sanitas* sawdust are used for a similar purpose.

Oleum Menthæ Viridis.—Oil of Spearmint (*not official*). The oil distilled from fresh flowering spearmint, *Meniha viridis* or *Meniha crispa* N.O. Labiatae.

Characters.—Colourless, pale yellow or greenish-yellow, becoming darker by age; with odour and taste of the herb. Sp. gr. 0.925 to 0.940. *Solubility*.—1 in 3 of alcohol 90 per cent.

Composition.—A ketone, *carvone*, $C_{10}H_{14}O$; an alcohol; *limonene* and *pinene*.

Aqua Menthæ Viridis (*not official*).—1 in 1,000, by distillation.

Its actions and uses are similar to those of oil of peppermint.

Oleum Lavandulæ (Lavender) and *Oleum Rosmarini* (Rosemary) resemble the other aromatic volatile oils in their action; they are chiefly employed as components of stimulating liniments.

Oleum Origanum.—Oil of *Origanum* (*not official*) may be obtained from *Origanum vulgare* (wild marjoram) or from other species of *Origanum*. It is an active irritant when rubbed into the skin, and is sometimes added to blisters and liniments.

Oleum Juniperi.—Oil of Juniper (*not official*). The oil distilled from the ripe fruit of *Juniperus communis*, N.O. Coniferae.

Characters.—Colourless or pale yellowish-green; odour characteristic; taste warm, aromatic, bitter. Sp. gr. 0.862 to 0.890. *Solubility*.—1 in 4 of a mixture of equal parts of absolute alcohol and alcohol 90 per cent.

Composition.—Oil of juniper contains a terpene, *pinene*, $C_{10}H_{16}$; a sesquiterpene, *cadinene*, $C_{15}H_{24}$; and *juniper camphor*, a crystalline terpene alcohol.

ACTIONS AND USES.—Oil of juniper is a stimulant, a carminative, an antispasmodic, and a stimulating diuretic. It is seldom employed in veterinary practice.

As a diuretic, the dose for horses and cattle is from $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{iii}$.

Oleum Cadinum (Ol. Cadin.).—Oil of Cade; Juniper Tar Oil. An empyreumatic, oily liquid obtained by the destructive distillation of the woody portions of *Juniperus oxycedrus*, N.O. Coniferæ.

Characters.—A dark reddish-brown, or nearly black, oily liquid; odour empyreumatic; taste aromatic, bitter, acrid. Sp. gr. 0.990.

Solubility.—Soluble in ether and chloroform; partially in cold, almost wholly in hot, alcohol 90 per cent.; very slightly in water.

Composition.—A sesquiterpene, *cadinene*, $\text{C}_{15}\text{H}_{24}$.

ACTIONS AND USES.—Oil of cade is occasionally used as a stimulating application to the skin in psoriasis and chronic eczema in the form of an ointment composed of oil of cade 1 part, with soft paraffin 4 parts.

Cardamomum (Cardam.).—Cardamomi Semina. Cardamom Seeds; Cardamom. The dried ripe seeds of *Elettaria cardamomum*, N.O. Scitamineæ. The seeds should be kept in their pericarps, and separated when required for use.

Characters.—Fruits from 1 to 2 cm. long; ovoid or oblong, bluntly triangular in section, shortly beaked at apex; pale buff, longitudinally striated. Seeds dark reddish-brown, about 3 mm. in length, breadth and thickness, irregularly angular, transversely wrinkled; enclosed in a thin, colourless, membranous aril. Odour aromatic; taste agreeably warm, aromatic.

Composition.—The active principle is a volatile oil (4.6 per cent.), containing a terpene, $\text{C}_{10}\text{H}_{16}$, and a camphor.

Tinctura Cardamomi Composita (Tinct. Cardam. Co.).—Cardamom; Caraway Fruit; Cinnamon Bark; Cochineal; Glycerin; Alcohol 60 per cent. By percolation.

Dose.—Dogs, $\mathfrak{M}\text{xx}$. to $\mathfrak{z}\text{i}$.

Cardamom possesses carminative and stomachic properties. The compound tincture is frequently used as a colouring and flavouring agent.

Aqua Rosæ.—Rose Water (*not official*). The rose water of commerce, prepared by distillation from the fresh flowers of *Rosa damascena*; diluted immediately before use with twice its volume of distilled water.

Rose water is mildly astringent and is employed in the preparation of eye-lotions in canine practice.

Valeriana (Valerian.).—*Valerianæ Rhizoma*. Valerian Rhizome; Valerian Root. The dried rhizome and roots of *Valeriana officinalis*, N.O. Valerianaceæ; collected in the autumn.

Characters.—Short, erect, entire, or sliced; dark yellowish-brown externally; with numerous slender brittle roots, 7 to 10 cm. long, of the same colour; whitish internally. Odour strong, characteristic, disagreeable; taste unpleasant, camphoraceous, slightly bitter.

Composition.—The active principle is the *volatile oil* (1 per cent.), which contains *bornyl isovalerianate*, *formate*, *butyrate*, and *acetate*, mixed with *l-pinene*, *l-camphene*, and *terpineol*. By ferment decomposition *isovalerianic acid*, $C_5H_{10}O_2$, an oily liquid with a powerful valerianic odour and acrid burning taste, is formed; two alkaloids, *chatinine* and *valerianine*, a *glucoside* and a *resin* have been recorded.

Tinctura Valerianæ Ammoniata (Tinct. Valerian. Ammon.).—Valerian Rhizome, 20; Oil of Nutmeg; Oil of Lemon; Solution of Ammonia; Alcohol 60 per cent., 90; by maceration.

Doses.—Horses, ʒi. to ʒii.; dogs, ℥xv. to ʒi.

ACTIONS AND USES.—Valerian possesses the actions of a typical volatile oil. It is antispasmodic, being stimulant to the stomach and intestines; it reflexly stimulates the heart, but is seldom employed in veterinary practice, and, except in large doses, has little effect on horses or cattle. The valerianates of sodium, zinc, and quinine have been prescribed somewhat empirically in chorea and epilepsy in the dog, but not with any beneficial effects.

Oleum Sinapis Volatile.—Volatile Oil of Mustard (*not official*).

Source.—The oil obtained by distillation from black mustard seeds deprived of most of their fixed oil and macerated in water for several hours.

Characters.—Colourless or pale yellow; odour intensely penetrating; taste very acrid. Almost immediately vesicates the skin.

Solubility.—Readily in alcohol and ether. Distils between 148° and 156° C. Sp. gr. 1.014 to 1.025. Contains not less than 92 per cent. of allyl-isothiocyanate.

Formation.—The seeds of black mustard (*Brassica niger*) contain: (1) about 27 per cent. of a bland *fixed oil*. When this is expressed, and the powdered mustard mixed with water and distilled, there is obtained (2) the official *volatile oil*, *oleum sinapis volatile*, C_6H_5CNS , allyl-isothiocyanate, described above. On the addition of water to the black mustard, its most important principle, *potassium myronate*, or *sinigrin*, $KC_{10}H_{18}NS_2O_{10}$ (a compound of potassium with an acid glucoside, *myronic acid*), is broken up by another constituent, *myrosin*, an enzyme, into volatile oil of mustard, potassium sulphate, and sugar, thus: $KC_{10}H_{18}NS_2O_{10} = C_6H_5CNS + KHSO_4 + C_6H_{12}O_6$.

The mustard of commerce consists of the powdered, mixed, dried, ripe seeds of *Brassica niger* and *Brassica alba*.

ACTIONS AND USES.—*Externally.*—Mustard made into a paste with water and applied with friction acts as a rubefacient and

vesicant. Repeated or prolonged applications may produce severe effects, resulting in destruction of the hair follicles.

Mustard is employed as a counter-irritant in the treatment of respiratory affections. It is made into a paste with tepid water and applied to the thoracic walls, the degree of friction employed varying according to the effects which it is desirable to produce. Too hot water, or the admixture of vinegar or spirit, prevents the essential oil from being formed by destroying the *myrosin*, and thus interferes with the activity of the application. When properly prepared and applied, counter-irritant effects are produced in about twenty minutes, and vesication occurs in from two to six hours. It is better to employ repeated mild applications than to depend on one strong dressing. When properly employed no blemish results.

The undoubted beneficial effects obtained from the application of mustard to the chest walls in the initial stages of feverish chills probably largely depend upon reflex stimulation of the heart and respiration.

Internally.—Mustard in small doses is stomachic, carminative, and stimulant.

In cattle practice it is prescribed as a stomachic in combination with carbonate of ammonia and nux vomica, in non-inflammatory gastric affections, associated with a paralyzed condition of the gastric walls. For this purpose doses of from ʒii. to ʒiv. may be given.

In the dog, mustard acts as a local emetic, and 1 to 4 teaspoonfuls dissolved in several ounces of warm water may be employed in cases of poisoning when other agents are not available.

Piper Nigrum.—Black Pepper. The dried *unripe* fruit of *Piper nigrum*, N.O. Piperaceæ. (*Not official.*)

Characters.—Globular, one-celled fruits. Odour aromatic; taste pungent.

Composition.—Pepper contains a *volatile oil*, with odour of pepper, mainly *phellandrene*, $C_{10}H_{16}$; a pungent resin, *chavicin*; and a tasteless crystalline alkaloid, *piperine*, $C_{17}H_{19}NO_3$.

The actions of pepper are similar to those of volatile oils generally. Pepper is a popular remedy for spasmodic colic in the horse, but is not used in veterinary practice.

Capsicum (Capsic.).—Capsici Fructus. The dried ripe fruit of *Capsicum minimum*, N.O. Solanaceæ.

Characters.—Dull orange red, oblong-conical, obtuse, two-celled fruits, 12 to 20 mm. long, about 6 mm. in diameter; sometimes attached to a five-toothed inferior calyx, and long, straight, slender

peduncle. Pericarp shrivelled, glabrous, translucent, leathery, with 10 to 20 small flat seeds, loose or attached to a reddish dissepiment. Odour characteristic; taste intensely pungent.

Composition.—Capsicum yields a crystalline pungent body, *capsaicin*, $C_{18}H_{28}O_3N$; a liquid alkaloid; a red colouring matter; and *fixed oil*.

Tinctura Capsici (Tinct. Capsic.).—Capsicum; Alcohol 60 per cent.; by maceration.

Doses.—For the horse, \mathfrak{z} ii. to \mathfrak{z} iv.; dog, \mathfrak{M} v. to \mathfrak{M} xv.

ACTIONS AND USES.—*Externally*.—Capsicum exerts rubefacient actions. Cotton-wool impregnated with capsicum is occasionally applied in canine practice as a mild rubefacient to the chest; but in a number of dogs capsicum wool causes severe irritation of the eyes.

Internally.—Although capsicum contains no volatile oil, its actions resemble those of the volatile oils in general. It is therefore stimulant, stomachic, and carminative; large doses produce gastro-intestinal irritation.

Cubebæ Fructus.—Cubebs (*not official*). The dried, full-grown unripe fruits of *Piper cubeba*, N.O. Piperaceæ.

Characters.—Nearly globular, about 4 mm. in diameter, greyish-brown or nearly black. Pericarp reticulately wrinkled, thin, brittle, abruptly prolonged at the base into a slender rounded stalk one and a half times as long as the globular portion; single seed spherical or shrivelled, attached by the base. Odour strong, aromatic, characteristic; taste warm, aromatic, somewhat bitter. Crushed fruit imparts a crimson colour to H_2SO_4 (presence of cubebic acid).

Composition.—Cubebs consists of 10 to 18 per cent. of the *volatile oil*; 2 per cent. of *cubebin*, $C_{10}H_{10}O_3$, a neutral.

Tinctura Cubebæ (*not official*).—Cubebs, 20; Alcohol, 90 per cent. to 100; by percolation.

Dose.—Dog, \mathfrak{M} x. to \mathfrak{M} xxx.

ACTIONS AND USES.—Cubebs acts as an expectorant, diuretic and urinary antiseptic. It is prescribed in cases of urethritis in canine practice.

The powdered fruit is occasionally used in cattle practice in cases of septic metritis with a view to preventing the extension of the septic process to the urethra.

Dose.— \mathfrak{z} ii. to \mathfrak{z} iv.

Copaiba (Copaib.).—Copaiba; Copaiva. The oleo-resin obtained by incision from the trunk of various species of *Copaifera*, N.O. Leguminosæ.

Characters.—A more or less viscous liquid; generally transparent, occasionally fluorescent; yellow to golden brown; odour peculiar, aromatic; taste acrid, somewhat bitter, persistent. Sp. gr. 0.975

to 0.995. *Solubility*.—Entirely soluble in absolute alcohol; 1 in 4 of petroleum spirit.

Composition.—Copaiba consists of about 45 per cent. of the official *volatile oil*, and more than 50 per cent. of *resin*. Resin of copaiba is a brownish resinous mass, consisting of resins, *copaivic acid*, $C_{20}H_{30}O_2$, and its derivatives. Forms transparent solution with one-third its volume of ammonia solution; 4 drops added to a mixture of 5 ml. glacial acetic acid and 4 drops of HNO_3 give no purple or violet colour (absence of Gurjun balsam); 1 g. in 52 ml. absolute alcohol with phenolphthalein requires not less than 2.7 ml. N/2 alcoholic KOH for neutralization (presence of due amount of acid resins).

Oleum Copaibæ (not official).—The oil distilled from Copaiba.

Characters.—Colourless or pale yellow; odour and taste of copaiba. Sp. gr. 0.896 to 0.910. Lævo-rotatory.

Composition.—A sesquiterpene, *caryophyllene*, $C_{15}H_{24}$.

Dose.—Dogs, ℥v. to ℥xv.

Copaiba has actions resembling those of cubebs, and may be prescribed in combination with it.

Oleum Santali (Ol. Santal.).—Oil of Sandal Wood; Oil of Santal Wood. The oil distilled from the wood of *Santalum album*, N.O. Santalaceæ.

Characters.—Viscid, pale yellow; odour strongly aromatic; taste unpleasant. *Solubility*.—1 in 6 of alcohol 70 per cent. Sp. gr. 0.973 to 0.985.

Composition.—Not less than 90 per cent. of total alcohols, as *santalol*, $C_{15}H_{24}O$; and aldehyde, *santalal*.

Dose.—Dogs, ℥v. to ℥xx.

Oil of sandal-wood has actions resembling those of cubebs and copaiba, and is employed as a urinary antiseptic.

Buchu (Buchu).—Buchu Leaves. The dried leaves of *Barosma betulina*, N.O. Rutaceæ.

Characters.—From 12 to 20 mm. long, dull yellowish-green, rhomboid-obovate, rigid; when slightly moist, cartilaginous. Surface glabrous, somewhat warty; margin usually sharply denticulate, apex blunt, recurved. Oil glands visible in the leaf, especially near the margin. Odour and taste strong, characteristic.

Composition.—Buchu contains a yellowish-brown *volatile oil*, in the glands or 'dots,' which deposits crystalline *diosphenol*, $C_{10}H_{16}O_2$, an antiseptic body; a *ketone*, probably menthone; a glucoside, *diosmin*; and *hesperidin*.

Tinctura Buchu (not official).—Buchu, 20; Alcohol, 60 per cent. to 100; by percolation.

Doses.—Horses, ʒi. to ʒii.; dogs, ʒss. to ʒi.

ACTIONS AND USES.—Buchu is a mild diuretic. It exerts astringent effects on the mucous membrane of the bladder and

urino-genital passages, and renders the urine antiseptic to a slight degree. It is prescribed in cystitis and in irritation of the bladder and urethra. It is usually combined with an alkali such as bicarbonate of potassium and with hyoscyamus, the vehicle being linseed-tea or barley-water.

PAREIRA (*not official*) and UVA URSI are agents possessing actions similar to those of buchu.

RESINS.

Colophonium (Coloph.).—Colophony, Resina, Resin.

Source.—The residue left after distillation of oil of turpentine from the crude oleo-resin (crude turpentine) of various species of Pinus, N.O. Coniferæ.

Characters.—Translucent, light amber, compact, brittle, pulverizable; fracture shining. Odour and taste faintly terebinthinate. *Solubility*.—Soluble in alcohol 90 per cent., ether, carbon bisulphide, and benzene. Readily fusible; burns with a dense yellow flame and much smoke, leaving no ash.

Composition.—Resin is the *anhydride* $C_{44}H_{62}O_4$ of the three isomeric *abietinic acids*, α , β , and γ , $C_{19}H_{28}O_2$; traces of volatile oil; and *resene*.

Emplastrum Colophonii (Emp. Coloph.).—Resin Plaster; Adhesive Plaster. Resin, 10; Lead Plaster, 85; Hard Soap, 5.

Unguentum Resinæ.—Resin Ointment (*not official*); 'Basilicon Ointment'; Resin, 26; Yellow Beeswax, 26; Olive Oil, 26; Prepared Lard, 22.

ACTIONS AND USES.—*Externally*, resin is stimulant, antiseptic, and astringent, and when melted and applied to a bleeding surface, it acts as a styptic. It is also used as an adhesive for plasters and strappings.

The ointment is a mild stimulating agent, and is sometimes employed in combination with other ointments to increase their consistency.

Internally, in doses of $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$., resin is a diuretic and mild astringent, and forms a common constituent of diuretic boluses and powders for horses.

Benzoinum (Benzoin.).—Benzoin. A resin obtained from the incised stem of *Styrax benzion*, N.O. Styracæ. Known in commerce as Sumatra benzoin.

Characters.—Hard brittle masses consisting of numerous whitish tears embedded in a greyish-brown translucent matrix. Softens readily when warmed, and when further heated evolves whitish fumes of benzoic acid. Odour agreeable, recalling that of storax; taste slightly acid. Slowly heated with solution of $KMnO_4$ evolves odour of benzaldehyde (distinction from Siam benzoin). *Solubility*.—Not more than 20 per cent. insoluble in alcohol 90 per cent.

Composition.—Benzoin contains about 18 per cent. of the official benzoic acid; 20 per cent. of cinnamic acid, $C_9H_8O_2$; two resins, benzoresinol and sumaresinotannol; vanillin and benzaldehyde.

Adeps Benzoinatus (Adeps Benz.).—Benzoated Lard. Benzoin, 3; Prepared Lard (in India, Prepared Suet), 100 (see p. 344).

Sevum Benzoatum.—Benzoated Suet (*not official*). Benzoin, 3; Prepared Suet, 100 (see p. 344).

Tinctura Benzoini Composita (Tinct. Benzoin. Co.).—Friar's Balsam. Benzoin, 10; Prepared Storax; Balsam of Tolu; Aloes; Alcohol 90 per cent. to 100; by maceration.

Acidum Benzoicum (Acid. Benz.).—Benzoic Acid; $C_6H_5.COOH$.

Source.—Prepared synthetically.

Characters and Tests.—Light feathery crystalline plates and needles; flexible; nearly colourless; and odourless when quite pure, but with an agreeable aromatic odour when sublimed from benzoin. *Solubility*.—1 in 450 of water; 1 in 3 of alcohol 90 per cent.; 1 in 2.5 of ether; 1 in 7 of chloroform. Volatilizes in the vapour of water. Sodium phosphate or borax aids its solubility in water (1 of borax and 1 of acid soluble in 100 of water).

Sodii Benzoas (Sod. Benz.).—Sodium Benzoate; $C_6H_5.COONa$.

Source.—Made by neutralizing benzoic acid with sodium carbonate.

Characters.—A white sub-crystalline or amorphous powder; no odour, or faintly of benzoin; taste unpleasant, sweetish, saline; reaction faintly alkaline. *Solubility*.—1 in 2 of water; 1 in 24 of alcohol 90 per cent.

Doses.—Horse, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{iv}$.; dog, grs. v. to grs. x.

Ammonii Benzoas.—Ammonium Benzoate; $C_6H_5.COONH_4$ (*not official*).

Source.—Neutralize benzoic acid with solution of ammonia.

Characters.—Colourless lamellar crystals; taste saline, slightly acrid. *Solubility*.—1 in 6 of water; 1 in 30 of alcohol 90 per cent. Sublimes without residue.

Doses.—Horse $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{iv}$.; dog, grs. v. to grs. x.

ACTIONS AND USES.—The actions of benzoin are almost identical with those of its preparations.

Externally.—The compound tincture of benzoin is a powerful stimulating antiseptic, and is specially indicated in the treatment of indolent sores, foul ulcers, etc.

Internally.—Benzoic acid possesses antiseptic, expectorant, antipyretic, and diuretic actions. It is a feeble urinary antiseptic, but renders the urine more acid, being excreted in the form of hippuric acid.

The sodium and ammonium salts of benzoic acid are preferred to the acid, as they are more soluble, and are less irritating to the alimentary canal. Sodium benzoate is prescribed as an intestinal antiseptic.

The compound tincture of benzoin is stimulant and antiseptic to the respiratory mucous membrane, and in the form of an

inhalation may be employed as an expectorant in bronchitis (2 drachms to each pint of hot water).

The *toxic symptoms* observed in benzoic acid poisoning consist in tremors and convulsions, followed by paralysis of the limbs; there is marked depression of the heart and respiration and gastric irritation.

OLEO-RESINS.

Myrrha (Myrrh.).—Myrrh. An oleo-gum-resin obtained from the stem of *Commiphora myrrha*, N.O. Burseraceæ, and probably other species.

Characters.—Rounded or irregular tears or masses, reddish-yellow or reddish-brown, dry, partly covered by a fine powder; brittle, fractured surface irregular, somewhat translucent, rich brown, oily, often with whitish marks; odour aromatic; taste aromatic, bitter, acrid.

Composition.—Myrrh contains *gum*, 40 per cent.; a volatile oil, $C_{10}H_{14}O$, *myrrhol*, 2 per cent.; and a resin, *myrrhin*, 45 per cent. *Impurities.*—Other resins; bdellium and false myrrh. True myrrh turns violet when moistened with nitric acid.

Tinctura Myrrhæ (Tinct. Myrrh.).—Myrrh, Alcohol 90 per cent. Macerate.

ACTIONS AND USES.—*Externally.*—Myrrh is a mild astringent and antiseptic, and the tincture forms a constituent of mouth-washes for the treatment of aphtha, etc.

A useful mouth-wash for sore spongy gums in the dog is prepared with tincture of myrrh, 1; borax, 1; syrup, 3; and water 16 parts.

Internally.—It is stomachic, carminative, and expectorant.

Myrrh is added to electuaries for laryngitis, etc., the dose for the horse being 2 drachms.

Asafoetida (Asafoet.).—Asafoetida. An oleo-gum-resin obtained by incision from the root of *Ferula fetida*, N.O. Umbelliferæ, and probably other species.

Characters.—Rounded or flattened tears from 12 to 25 mm. in diameter, or masses of tears, greyish-white to dull yellow, darkening on keeping. Fresh tears tough at ordinary temperatures, hard when cold. Internally yellowish, translucent or milky white and opaque; freshly exposed surfaces slowly become pink, then red, and finally reddish-brown. Contains not more than 50 per cent. of matter insoluble in alcohol 90 per cent. Taste bitter, acrid, alliaceous; odour strong, alliaceous, persistent. Triturated with water, forms a white emulsion. Freshly fractured surface with H_2SO_4 gives a red colour. Solution in alcohol gives no blue fluorescence with NH_4OH (distinction from galbanum).

Composition.—Asafoetida contains 5 per cent. of a volatile oil, 65 per cent. of resin, and 25 per cent. of gum. The oil contains *pinene* and *disulphides*. The resin is a ferulic acid ester of *asaresino-*

tannol, $C_{24}H_{35}O_5$; free ferulic acid, $C_{10}H_{10}O_5$, is also present. *Impurities*.—Earthy matters.

Tinctura Asafetidae (Tinct. Asofet.).—Asafetida; Alcohol 70 per cent.; by maceration.

Doses.—Horses, ʒss. to ʒii.; dogs, ℥x. to ℥xx.

When the tincture is mixed with water, precipitation of the resin occurs; the precipitate may be redissolved by the addition of ammonia.

ACTIONS AND USES.—Asafetida is occasionally used as a carminative and antispasmodic. It is sometimes prescribed in flatulent colic in combination with oil of turpentine and linseed-oil.

BALSAMS.

Balsamum Tolutanum (Bals. Tolu.).—Balsam of Tolu. A balsam obtained from incisions made in the trunk of *Myroxylon toluiferum*, N.O. Leguminosæ.

Characters.—A soft, tenacious solid, becoming hard by keeping, and finally brittle. Transparent, yellowish-brown in thin films, presenting microscopically crystals of cinnamic acid. Odour fragrant, especially when warmed; taste somewhat aromatic, slightly acid. *Solubility*.—In alcohol 90 per cent. with acid reaction.

Composition.—Balsam of tolu contains free *cinnamic acid* 12 per cent.; *benzyl benzoate*; *benzyl cinnamate*; a resin, yielding *benzoic acid* and *tolu-resinotannol*; *vanillin*; and a *terpene*.

Syrupus Tolutanus (Syr. Tolu.).—Tolu Balsam, 2.5; Refined Sugar; Water to 100.

Doses.—Dogs, ℥x. to ℥xxx.

ACTIONS AND USES.—Balsam of tolu is partly excreted by the respiratory mucous membrane, on which it exerts a stimulant and antiseptic action. The syrup of tolu is added to expectorant mixtures in canine practice.

Balsamum Peruvianum (Bals. Peruv.).—Balsam of Peru. A balsam exuded from the trunk of *Myroxylon pereiræ*, N.O. Leguminosæ, after the bark has been beaten and scorched.

Characters and Tests.—A viscid liquid; in bulk nearly black, in thin layers deep orange-brown or reddish-brown and transparent. Odour agreeable, balsamic; taste acid; when swallowed, leaving a burning sensation in the throat. Sp. gr. 1.140 to 1.158. *Solubility*.—Insoluble in water; soluble in chloroform; 1 in 1 of alcohol 90 per cent., but on further addition of 2 or more volumes turbidity occurs.

Composition.—Balsam of Peru is a complex substance. It consists of not less than 57 per cent. of *cinnamein*, a colourless aromatic oily fluid, and about 28 per cent. of dark *resin*. The liquid is a mixture of *benzyl benzoate*, $C_7H_7 \cdot C_6H_5 \cdot COO_2$, and *benzyl cinnamate*, $C_7H_7 \cdot C_6H_4 \cdot COO$; the resin of an alcohol (*peru-resinotannol*) united to *cinnamic* and *benzoic acids*; there are also an alcohol (*peruvial*) with a sweet odour and taste, *vanillin*, and free *cinnamic acid*.

ACTIONS AND USES.—Balsam of Peru is antiseptic and acaricide, and is commonly used in the treatment of mange in the dog. For this purpose it is dissolved in 4 parts of alcohol and applied as a liniment, or used in the form of an ointment containing 1 part of balsam of Peru in 8 parts of lanolin or soft paraffin.

Styrax (Styr.).—*Styrax Præparatus*. Prepared Storax. A balsam obtained from the wounded trunk of *Liquidambar orientalis*, N.O. Hamamelideæ, purified by solution in alcohol, filtration, and evaporation of the solvent.

Characters.—Brownish-yellow, viscous, transparent in thin layers; odour and taste agreeable, balsamic. **Solubility.**—Entirely in alcohol 90 per cent. and ether. Boiled with solution of potassium bichromate and sulphuric acid, it evolves an odour of benzaldehyde.

Composition.—Storax consists of not less than 20 per cent. of *cinnamic acid*; with a volatile oil, *styröl*, C_8H_8 ; *cinnamate of cinnamyl* (*styracin*), C_8H_7CO, OC_8H_7 ; a resin, *storesinol*.

Storax resembles balsam of Peru and tolu, and, incorporated with 4 parts of soft paraffin, is employed as a non-irritating parasiticide for the dog.

TARS.

Pix Liquida (Pix. Liq.).—Tar; Stockholm Tar. A bituminous liquid obtained from the wood of *Pinus sylvestris*, N.O. Coniferæ, and other species of *Pinus* by destructive distillation.

Characters.—Semi-liquid, dark brown, or nearly black; odour characteristic, empyreumatic; heavier than water. Water shaken with it acquires a pale brown colour, sharp empyreumatic taste, and acid reaction; dilute Fe_2Cl_6 solution colours it red. **Solubility.**—1 in 10 of alcohol 90 per cent.

Composition.—A variable mixture of *creosol*, *crasol*, *phenol*, *pyrocatechol*, *guaiacol*, *toluene*, *xylene*, *naphthalene*, and *resinoids*.

Unguentum Picis Liquidæ.—Tar Ointment (*not official*). Tar, 70; Prepared Lard, 5; Yellow Beeswax, 25.

Oleum Picis Liquidæ.—Oil of Tar (*not official*).

A volatile liquid distilled from tar.

Oleum Picis Rectificatum.—Light Oil of Tar; also known as Rectified Spirit of Tar (*not official*).

ACTIONS AND USES.—Tar, although less powerful than oil of turpentine, closely resembles that drug in its actions, and is stimulant, expectorant, antiseptic, and parasiticide; it is useful for the purpose of alleviating itching and irritability of the skin arising either from parasitic or non-parasitic causes.

Externally.—Tar is employed in the treatment of chronic, dry skin eruptions, 1 part of the ointment being mixed with 4 parts of

zinc oxide ointment. As a hoof ointment and stopping for horses' feet, in dryness and brittleness of the wall, tar combined with other agents is found useful, and the following may be employed for this purpose: 4 ounces each of tar and beeswax; 3 ounces of glycerin; and $1\frac{1}{2}$ pounds of veterinary lanolin. The lanolin and the beeswax are first melted together, and the other ingredients then stirred in.

Tar, combined with soft soap, iodine, and lanolin, is employed as an absorbent application to bursal enlargements, thickened tendons, etc.

For foot-rot in sheep, tar ointment forms a useful dressing.

Oil of tar, combined with sulphur, sperm-oil, and an alkali such as potassium carbonate, was much employed as a dressing for mange in the horse, but has been largely replaced by simpler and less irritant applications.

The rectified spirit of tar, combined with an equal amount of linseed-oil, forms a useful absorbent liniment in bursal distensions, being applied with a brush once daily.

Spirit of tar combined with iodine is employed in the treatment of ringworm.

Pix Carbonis Præparata (Pix Carb. Præp.).—Prepared Coal Tar.

Source.—Obtained by maintaining commercial coal tar in a shallow vessel at 50° C. for one hour, stirring frequently.

Characters.—A nearly black, viscous liquid; brown in very thin layers; heavier than water; odour characteristic, strongly empyreumatic. *Solubility.*—Almost entirely in benzene and chloroform; partially in alcohol 90 per cent. and in ether; very slightly in water.

Composition.—A complex mixture of hydrocarbons: *benzene, toluene, naphthalene, anthracene, phenol compounds, anilin*, etc.

Liquor Picis Carbonis (Liq. Pic. Carbon.).—Solution of Coal Tar. Prepared Coal Tar, 20; digested for seven days with Quillaia Bark, 10, and Alcohol 90 per cent., 100, and filtered.

Liquor Carbonis Detergens (*not official*).—This is an alcoholic solution of coal tar. It is said to owe its properties in part to phenol.

Coal tar resembles tar in its actions. In veterinary practice the solutions of coal tar are principally used as parasiticides (5 per cent. in water).

Pix Nigra—Black Pitch (*not official*).

The residue remaining after the distillation of tar.

Pitch is employed in the form of plasters and charges for surgical purposes.

Pix Burgundica—Burgundy Pitch (*not official*).—The prepared resinous exudate from the stem of *Picea excelsa*, the spruce fir-tree.

It is employed as a stimulant and adhesive plaster in the treatment of bursal enlargements, etc., and for this purpose is spread on chamois leather or on bandages.

EMPLASTRUM PICIS—Pitch Plaster (*not official*)—

Burgundy pitch, 26; frankincense, 13; resin, 4½; yellow bees-wax, 4½; olive-oil, 2; and distilled water, 2. These are melted together and evaporated to the consistence of a plaster.

VEGETABLE PURGATIVES.

(I). ANTHRACENE GROUP.

The following drugs—aloes, rhubarb, cascara, and senna—owe their purgative properties to the presence of irritant anthracene compounds, of which the most important are *emodin* and *chrysophanic acid*, derivatives of anthraquinone. They act upon the large intestines; their purgative action is slow in its development and is accompanied by considerable griping.

Aloe (Aloe).—Aloes. The juice from the transversely-cut leaves of *Aloe chinensis*, *Aloe perryi*, and probably other species, N.O. Liliaceæ; evaporated to dryness. Known in commerce as Cape aloes, Curaçao aloes, Socotrine aloes, or Zanzibar aloes.

Characters.—In hard masses, varying from yellowish-brown to dark or chocolate brown. Fracture dull, waxy and uniform (Curaçao and Zanzibar aloes), or uneven and somewhat porous (socotrine aloes). Small splinters examined under the microscope exhibit minute crystals embedded in a transparent mass. Odour characteristic; taste nauseous, bitter. **Solubility.**—Almost entirely in alcohol 60 per cent. Nitric acid dropped on crushed aloes acquires a reddish-brown colour (Socotrine and Zanzibar aloes) or a crimson colour (Curaçao aloes). **Impurities.**—Natal aloes, giving a bright-blue coloration if the vapour of HNO_3 is blown over the powder previously mixed with H_2SO_4 . **Substances resembling Aloes.**—Guaïac resin, Jalap resin; not bitter.

Composition.—Aloes contains: (1) the official *aloin*; (2) *aloe resin*, a brown translucent body, insoluble in water; (3) *aloe-emodin*, $\text{C}_{15}\text{H}_{10}\text{O}_5$; (4) a *volatile oil*, the source of the odour of aloes; and various less important bodies.

Barbados aloes (*Aloe barbadensis*) is the variety employed in veterinary practice.

Doses.—As a *purgative*: Horses, ℥iv. to ℥viii.; cattle, ℥i. to ℥ii.; sheep and pigs, ℥ii. to ℥iv.; dogs, grs. x. to grs. xxx. As a *bitter stomachic*, ʒ to ʒss of these doses is prescribed.

The purgative dose varies in different parts of the country; thus in Scotland very much larger doses of aloes are required to produce catharsis than in the South of England.

Aloinum (Aloin).—Aloin; $C_{21}H_{20}O_9$. A crystalline principle obtained from aloes.

Characters.—A pale-yellow micro-crystalline powder; almost inodorous; taste intensely bitter. **Solubility.**—1 in 130 of water; 1 in 18 of alcohol 90 per cent.; 1 in 50 of acetone; sparingly in ether, chloroform, benzene; readily in dilute ammonia, the liquid becoming red with a greenish-red fluorescence.

Composition.—Consists chiefly of *barbaloin*, $C_{21}H_{20}O_9$, and *isobarbaloin* in equal proportions. Barbaloin is a methyl-anthraquinone glucoside, splitting up into *aloe-emodin* or trihydroxymethyl-anthraquinone and aloinose. In socotrine and Zanzibar aloin β -barbaloin replaces isobarbaloin.

Doses.—As a purgative: Horses, \mathfrak{z} i.ss. to \mathfrak{z} ii.; dogs, grs. ii. to grs. x.

ACTIONS—**Externally.**—Aloes in the form of an aqueous solution is stimulant and desiccant when applied to wounds, but is very rarely employed for these purposes.

Internally.—Aloes is a purgative, and in small doses a bitter stomachic. By directly irritating the mucosa of the large bowel it increases the peristaltic movements and augments the intestinal secretions. It is, however, doubtful whether aloes possesses any stimulant action on the secretory glands of the intestine, and the increase of fluid in the bowels which results from the administration of the purgative is probably due to the increased rate of peristalsis, which expedites the passage of the normal secretions from the liver, pancreas, and intestines, giving insufficient time for their absorption (see p. 64).

In the horse, the action of aloes as a purgative is slow if given in the form of bolus, and if the horse be unprepared for the drug, a medicinal dose may not take effect for sixteen to twenty-four hours after administration, and its action may be accompanied by griping pains. If the animal be properly prepared by feeding on bran-mashes for two days prior to administration, purgation may result in about twelve hours.

In order that aloes may exert its purgative action, it must be subjected to the solvent action of the bile, in which it is emulsified. The purgative action in the horse varies in its duration from three to twenty-four hours. In some cases medicinal doses produce no purgative action, but are excreted by the kidneys, exerting a diuretic effect.

If aloes be dissolved in warm water and given as a draught, purgation in the horse is much more quickly induced, but in whatever form the drug is administered, its purgative action is frequently accompanied by considerable nausea and depression.

In ruminants the effect of aloes is uncertain; but if combined with other cathartic agents, it assists their action.

In the dog its action is also uncertain, and, as compared with man, much larger doses are tolerated.

Aloes reflexly causes contraction of the gravid uterus.

MEDICINAL USES.—Aloes is commonly employed as a purgative for the horse and is most easily given in the form of a bolus. The bolus mass should be properly prepared by melting the aloes, and adding glycerin with some volatile oil to prevent hardening and drying. The temperature employed for melting the ingredients should not exceed 120° F., otherwise the activity of the aloin becomes impaired. Gelatin-coated boluses of aloes are now prepared by wholesale chemists. The coating preserves their activity and facilitates their administration.

In order to prevent griping, it is advisable to incorporate 2 drachms of powdered ginger, 10 grains of extract of belladonna, and 10 minims of oil of peppermint, in each bolus. The addition of gentian is advised, since it is generally believed that it increases the activity of the aloin; but this admits of doubt.

In prescribing aloes as a purgative, care must be observed in computing the suitable dose. An insufficient amount may be retained and cause extreme nausea. In cases in which the purgative fails to act, its administration should not be repeated for a period of at least forty-eight hours.

Before administering aloes in bolus the horse should be fed on mashes for twenty-four to forty-eight hours. About twelve hours after administration gentle walking exercise hastens the action of the drug; but when purgation has commenced the animal should be kept in his stall and properly clothed. Cold water should be replaced by tepid drinks, and bran-mashes should constitute the diet until purgation has ceased. Green foods, roots, etc., should be rigidly interdicted, and on no account should the animal be worked until purgation has completely passed off. Neglect of these precautions may give rise to superpurgation, which in the horse not infrequently proves fatal. Sometimes, in consequence of individual idiosyncrasies to the action of the drug, even a moderate dose may induce superpurgation, or laminitis may supervene. Such unfortunate occurrences, however, are rare, and by observing the conditions mentioned above and the contra-indications which will be presently noticed properly regulated doses are usually safe.

The superpurgation resulting from the action of aloes requires appropriate treatment. If no constitutional disturbance be present, it is irrational to adopt heroic measures to check purgation; demulcent drinks, such as thin flour-gruel, should be

allowed, and the animal kept warmly clothed. If purgation continue, and if in addition there be disturbance of the pulse, loss of appetite, or colicky pains, it will be necessary to check the purgation gradually. For this purpose, and to relieve the pain, the tincture of opium, or chlorodyne, with prepared chalk, spirits of camphor, and flour-gruel, may be administered every four hours until relief be obtained. In cases in which prostration is marked, full doses of brandy or port wine should be added to the draughts.

Since the action of aloes is comparatively rapidly exerted when the drug is given in solution, aloes draughts are largely employed in the treatment of obstructive colic in the horse.

In combination with other agents, aloes is occasionally prescribed as a bitter tonic for the horse.

Aloes is not a reliable purgative for cattle, but is occasionally combined with other cathartic agents, such as magnesium sulphate.

Dogs require comparatively large doses to induce purgation, and aloes is now seldom employed in canine practice.

CONTRA-INDICATIONS OF ALOES.—Aloes should not be prescribed in inflammatory conditions of the alimentary canal, in peritonitis, in nephritis, in laminitis, or in advanced pregnancy.

In catarrhal or respiratory affections, and in all conditions of debility, aloes is contra-indicated, as not only is there a danger of superpurgation ensuing, but the depressant action of the purge may be followed by serious, if not fatal, consequences. It should not be employed as a purgative for young animals.

ALOIN causes less nausea and is less liable to produce griping, while the dose required is about one-third that of aloes. Thus, 2 drachms of aloin, administered to horses properly prepared, produce purgative effects equivalent to those of 6 drachms of aloes. Aloin ʒii. with calomel ʒii. forms an efficient purgative, and may be given in the form of bolus or in the food.

In recent years there has been prepared synthetically a number of anthraquinone products which are used as purgatives for the horse. These usually occur as light brown amorphous powders, possess only slight taste and smell, and are taken readily in a bran mash. They act slowly but are reliable and effective.

Rheum (Rheum).—Rhei Rhizoma. Rhubarb. The rhizome of *Rheum palmatum*, and probably other species, N.O. Polygonaceæ; collected in China and Tibet; deprived of most of the cortex, and dried.

Characters.—Compact, firm, cylindrical, barrel-shaped, conical, or plano-convex pieces; often perforated, holes often containing a

fragment of cord; surface usually covered with a bright brownish-yellow powder; rounded or slightly angular, marked beneath the powder with reddish-brown lines, embedded in a white ground-substance, and nearly always presenting small, scattered, starlike marks. Fracture granular, uneven, exhibiting reddish-brown points and lines on a white-ground substance. Odour characteristic, somewhat aromatic; taste bitter, feebly astringent.

Composition.—Rhubarb root contains purgative anthraquinone derivatives (p. 302): *chrysophanic acid*, $C_{15}H_{10}O_4$, *emodin*, $C_{15}H_{10}O_5$, *rhein*, $C_{15}H_{10}O_6$; *rheotannic acid*, composed of glucosides *glucogallin*, $C_{13}H_{16}O_{10}$, *tetrarin*, $C_{32}H_{32}O_{10}$, and an aldehyde, *rhæosmin*, $C_{10}H_{12}O_2$, is astringent. Starch and calcium oxalate are also present. *Impurities.*—Excess of starch; turmeric, turned brown by boric acid.

DOSES OF POWDERED RHUBARB.—For foals and calves, $\mathfrak{z}\text{ii.}$; dogs, grs. xv. to $\mathfrak{z}\text{ss.}$ As a stomachic tonic for the dog, grs. iii. to grs. x., for repeated administration.

Tinctura Rhei Composita (Tinct. Rhei Co.).—Rhubarb, 10; Cardamom Seeds, 1·25; Coriander Fruit, 1·25; Glycerin, 10; Alcohol 60 per cent. to 100 by percolation.

DOSE.—For the dog, $\mathfrak{z}\text{ss.}$ to $\mathfrak{z}\text{i.}$

Pulvis Rhei Compositus (Pulv. Rhei Co.).—‘Gregory’s Powder.’ Rhubarb, 25; Heavy Magnesium Carbonate, 32·5; Light Magnesium Carbonate, 32·5; Ginger, 10.

DOSES.—Calves and foals, $\mathfrak{z}\text{ii.}$ to $\mathfrak{z}\text{iv.}$; dogs, grs. x. to $\mathfrak{z}\text{i.}$

ACTIONS AND USES.—Rhubarb, even in large doses, has no purgative effect on adult horses or cattle. In the dog in full doses it acts as a typical anthracene purgative, but purgation is followed by an astringent action, believed to be due to the rheotannic acid. Rhubarb is therefore particularly useful in diarrhoea dependent upon the presence of irritant matter in the bowel. It is usually prescribed in the form of the compound powder, small doses of which exert stomachic, tonic, and astringent actions. Combined with grey powder, the compound rhubarb powder in larger doses forms an efficient purgative for the dog. It may be given in diarrhoea, in combination with sodium bicarbonate and peppermint-water. In obstinate diarrhoea in foals and calves the compound powder often proves effectual. In some cases it is advisable to combine with the above $\frac{1}{2}$ drachm of chlorodyne and 1 ounce of brandy, and to administer the draught twice daily in well-boiled wheat-flour gruel.

Cascara Sagrada (Casc. Sagr.).—Cascara Sagrada; Rhamni Purshiani Cortex; Sacred Bark. The dried bark of *Rhamnus Purshianus*, N.O. Rhamneæ. Collected at least one year before being used.

Characters.—Quilled, channelled, or nearly flat pieces, 1 to 2 mm. thick, varying in length and width. Cork nearly smooth, dark purplish-brown, with transversely elongated lenticels, usually covered with patches of silvery-grey lichen. Inner surface reddish-

brown, transversely corrugated, longitudinally striated. Fracture short; internally somewhat fibrous. Odour characteristic, not powerful; taste persistent, bitter, nauseous.

Composition.—Cascara contains *emodin* and *frangula-emodin* about 2 per cent.; *fats*, *glucose*; a bitter principle. *Cascarine*, $C_{12}H_{10}O_5$, is said to be impure.

Extractum Cascaræ Sagradæ Siccum (Ext. Casc. Sagr. Sicc.).—Aqueous; dried.

Dose.—Dogs, grs. ii. to grs. viii.

Extractum Cascaræ Sagradæ Liquidum (Ext. Casc. Sagr. Liq.).—Alcoholic and aqueous; by percolation. 1 in 1.

Dose.—Dogs, 3ss. to ʒi.

ACTIONS AND USES.—Cascara sagrada is a comparatively mild anthracene purgative. It is chiefly employed as a tonic laxative in chronic constipation in the dog, depending on an atonic condition of the intestines. It is best given in small doses once or twice daily, the amount being gradually reduced as the normal action of the intestines returns. Its bitter principle renders it slightly stomachic, and it is one of the safest and most satisfactory laxatives for the dog.

Senna, the dried leaflets and pods of *Cassia acutifolia* and *Cassia angustifolia*, is an anthracene purgative, but is not employed in veterinary practice.

(2). DRASTIC PURGATIVES.

Drastic purgatives contain irritant glucosidal resins. Their cathartic action depends upon direct irritation of the small and large intestines.

Jalapa (Jalap.).—Jalap. The dried tubercles of *Ipomœa purga*, N.O. Convolvulaceæ.

Characters.—Dark-brown, irregularly oblong, ovoid, napiform or fusiform tubercles, 3 to 8 cm. or more long, the larger often incised; hard, compact, heavy; externally wrinkled, marked with transverse scars; internally yellowish-grey to dingy brown. Transverse sections usually show irregular dark concentric lines and, microscopically, a resinous emulsion in cells. Odour characteristic; taste sweet, then acrid.

Composition.—Jalap yields 9 to 11 per cent. of official resin, which contains two glucosides: *convolvulin*, $C_{34}H_{56}O_{18}$, 90 per cent., insoluble in ether; and *jalapin*, $C_{34}H_{56}O_{18}$, 10 per cent., soluble in ether.

Jalap. Pulverata (Jalap. Pulverat.).—Powdered Jalap. Adjusted to contain 10 per cent. of resin.

DOSES OF POWDERED JALAP.—Pigs, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, grs. x. to \mathfrak{z} ss.

Pulvis Jalapæ Compositus (Pulv. Jalap. Co.).—Jalap; Acid Potassium Tartrate; Ginger.

DOSES.—Pigs, \mathfrak{z} ii. to \mathfrak{z} vi.; dogs, grs. x. to \mathfrak{z} i.

Tinctura Jalapæ (*not official*).—Jalap, in Alcohol 70 per cent.; by percolation. *Standardized* to contain from 1.45 to 1.55 g. of jalap resin in 100 ml.

DOSES.—Pigs, \mathfrak{z} i. to \mathfrak{z} ii.; dogs, \mathfrak{M} v. to \mathfrak{z} ss.

ACTIONS AND USES.—Jalap, even in large doses, has little effect on horses or cattle, but is an effectual cathartic for the pig. At one time it was a favourite purgative for the dog, but the use of hydragogue cathartics in canine practice is very rarely indicated.

Scammonia Resina (Scammon. Res.).—Scammony Resin. A mixture of resins obtained from *Orizaba* jalap root.

Source.—Made by precipitating in water a concentrated tincture; washing and drying.

Characters.—Brownish, translucent, brittle fragments; resinous in fracture; odour characteristic, agreeable; taste acrid. Powder pale brown. Soluble in alcohol 90 per cent., and not less than 75 per cent. soluble in ether. **Impurities.**—Other resins.

Pulvis Scammonia Compositus (*not official*).—Scammony Resin, 50; Jalap, 35; Ginger, 15.

DOSES.—Horses, \mathfrak{z} i. to \mathfrak{z} iii.; pigs, grs. viii. to grs. xx.; dogs, grs. iii. to grs. x.

Scammony is a typical drastic purgative. In veterinary practice it is usually prescribed as the compound colocynth pill.

Colocynthis (Colocynth.).—Colocynthis Pulpa. Colocynth Pulp. The dried pulp of the fruit of *Citrullus colocynthis*, N.O. Cucurbitaceæ, freed from seeds.

Characters.—White, spongy, light fragments. No odour; taste intensely bitter. **Impurities.**—Seeds and cortex, ground up with the pulp; starch.

Composition.—Colocynth contains a bitter purgative glucoside, *colocynthin*, $\text{C}_{56}\text{H}_{84}\text{O}_{23}$, readily soluble in water and alcohol; an amorphous purgative body; and δ -*elaterin*, *citrullol*, etc., which are inactive.

Pilula Colocynthis et Hyoscyami (Pil. Colocynth. et Hyoscy.).—Colocynth; Aloes; Scammony Resin; Curd Soap; Oil of Clove; Dry Extract of Hyoscyamus; Syrup of Liquid Glucose.

DOSE.—Dogs, grs. ii. to grs. viii.

Pilula Colocynthis Composita (*not official*).—Colocynth Pulp, 20; Aloes, 35; Scammony Resin, 35; Potassium Sulphate, 5; Oil of Cloves, 5; Water, q.s.

Dose.—Dogs, grs. ii. to grs. vi.

ACTIONS AND USES.—Colocynth is a powerful hydragogue cathartic. It is not prescribed for horses or cattle, but, in combination with other agents, it is employed as a purgative for the dog. In the form of the pill of colocynth and hyoscyamus it may be combined with grey powder.

Podophylli Resina (Podoph. Res.).—Podophyllum Resin; Podophyllin.

Source.—Made by percolating with alcohol 90 per cent.; precipitating the resulting tincture in water acidulated with hydrochloric acid; washing and drying.

Characters.—A pale-yellow to deep orange-brown amorphous powder; soluble in alcohol 90 per cent. and in ammonia, partly soluble in ether. Precipitated from alcoholic solution by water; from the ammoniacal by acids.

The resin contains the purgative principles, the precise identity of which is still uncertain.

Doses.—Horses, grs. xv. to grs. xl.; dogs, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$.

Tinctura Podophylli (*not official*).—Podophyllum Resin, 3.65; Alcohol 90 per cent. to 100; by maceration.

Dose.—Dogs, ℥v. to ℥xv.

ACTIONS AND USES.—Podophyllum is uncertain in its actions on horses and cattle, and medicinal doses frequently produce no effect. In the dog, small doses are laxative; full doses are purgative, but usually cause irritation and griping. As a purgative and cholagogue, the drug is frequently combined with grey powder.

Cambogia—Gamboge (*not official*).

A gum-resin obtained from *Garcinia hanburii*.

Characters.—Hollow cylindrical moulds, orange red in colour; brittle, readily powdered; forms a yellow emulsion with water; disagreeable acrid taste.

Dose.—For cattle, ʒss. to ʒi.

ACTIONS AND USES.—Gamboge is a drastic hydragogue cathartic. It is much too irritant for horses or dogs, but is occasionally prescribed in combination with other purgatives, such as salines and aloes, in conditions in which free purgation is indicated in cattle.

Oleum Crotonis.—Croton Oil (*not official*). The oil expressed from the seeds of *Croton tiglium*, N.O. Euphorbiaceæ.

Characters.—Brownish-yellow to dark reddish-brown; viscid; slightly fluorescent; odour disagreeable; cautiously tasted, acrid; blisters skin and mucous membrane. **Solubility.**—Miscible with half its volume of absolute alcohol; freely soluble in ether and in chloroform. Sp. gr. 0.940 to 0.960.

Characters of the Seeds (*not official*).—About the size of a coffee bean, oval or oval-oblong, dull brownish-grey, without odour. **Substances resembling Croton-Oil Seeds.**—Castor-oil seeds, which are bright, polished, and mottled.

Composition.—The active and vesicant principle of croton-oil is a lactone, *croton-resin*, $C_{13}H_{18}O_4$, an exceedingly purgative principle. Several fixed oils (*olein, palmitin, stearin, myristin, and laurin*), as well as their free acids, can also be extracted from it; and several volatile acids (only 1 per cent. in all), which give its odour to croton-oil—namely, *acetic, butyric, valerianic, and tiglic* ($HC_8H_7O_2$) acids. *Crotonoleic acid* is a mixture of croton resin with inactive fatty acids. **Impurities.**—Other non-drying oils.

Doses.—Horses, ℥x. to ℥xx.; cattle, ʒss. to ʒi.; pigs, ℥v. to ℥x.

Linimentum Crotonis (*not official*).—Croton Oil, 12; Oil of Cajuput, 44; Alcohol 90 per cent., 44.

ACTIONS AND USES—Externally.—Croton-oil is an irritant, and when rubbed into the skin of horses produces pustulation. The pustules heal slowly, and are liable to leave a blemish.

Croton-oil, in the form of LINIMENTUM CROTONIS, is employed as a counter-irritant for cattle. It may be added to the ordinary blistering ointments in the proportion of 1 to 8. Because of the severity of its action it is not used as a counter-irritant for horses.

Internally.—Croton-oil is irritant to the intestinal mucous membrane, and is a powerful drastic hydragogue cathartic, which acts with great rapidity, causing frequent full fluid dejections. In large doses it is an irritant poison, inducing gastro-enteritis, collapse, and death. In some instances even medicinal doses may produce serious intestinal irritation and superpurgation.

In consequence of its irritating and depressing action, croton-oil is seldom employed for the horse. It is occasionally useful in the earlier stages of phrenitis and meningitis when it is desirable to obtain speedy and complete purgation, and a diminution of general blood-pressure by diverting the blood to the intestinal bloodvessels.

In cattle it is sometimes prescribed in gastric affections complicated with cerebral symptoms; but its use requires great care, as many such cases depend on an inflammatory condition of the abomasum, in which the drug is contra-indicated.

Croton-oil may be administered in linseed-oil or in mucilage.

Although occasionally prescribed for the pig, it is not employed in canine practice, being much too irritant and violent in its actions.

Euonymi Cortex.—*Euonymus* Bark (*not official*). The dried root-bark of *Euonymus atropurpureus*, N.O. Celastrineæ.

Characters.—Quilled or curved pieces, 2 to 4 mm. thick; outer layer is soft friable cork, ash-grey with dark patches; pale tawny-white and smooth within; fracture short, surface yellowish. Transverse section shows in the secondary bast lactiferous cells filled with a granular elastic substance. Odour faint, characteristic; taste somewhat mucilaginous, afterwards bitter and acrid.

Composition.—A crystalline alcohol, *euonymol*, $C_{21}H_{30}O_4$, *dulcitol*, *carboxylic acid*, *citrullol*, sugars and fatty acids.

Extractum Euonymi.—Extract of *Euonymus*; 'Euonymin' (*not official*). Alcoholic, 45 per cent.; by percolation; incorporated with calcium phosphate and dried.

Dose.—Dog, grs. i. to grs. ii.

Euonymus is a purgative and indirect cholagogue occasionally prescribed in canine practice in the treatment of chronic constipation. It has an action on the heart resembling that of *digitalis*.

Drastic purgatives are now seldom used in cases of obstinate constipation. Many cases of cessation of rumination and obstinate constipation in cattle are associated with an inflammatory condition of the abomasum, and in such instances violent purgatives are more harmful than they are beneficial.

(3). OLEAGINOUS PURGATIVES.

Oleum Ricini (Ol. Ricin.).—Castor-Oil. The oil expressed from the seeds of *Ricinus communis*, N.O. Euphorbiaceæ.

Characters.—Viscid; nearly colourless or with a yellowish tinge. Liable to solidify at low temperatures. Odour slight; taste bland at first, then acrid and unpleasant. **Solubility.**—In all proportions of absolute alcohol; 1 in 3.5 of alcohol 90 per cent. Sp. gr. 0.958 to 0.970.

Characters of the Seeds (*not official*).—Oval, compressed, smooth, shining, grey, marbled with reddish- or blackish-brown spots and stripes.

Resembling Castor-Oil Seeds.—Croton seeds (*q.v.*).

Composition.—Chiefly *ricinolein*, a mixture of glycerides of *ricinoleic acid*, $C_3H_5(C_{18}H_{33}O_2)_3$, and *isoricinoleic acids*; glycerides of *stearic* and *dihydroxystearic acids*. **Impurities.**—Various fixed oils.

Castor-oil undergoes saponification in the intestine, and as a result *ricinoleic acid* and irritant *ricinoleates* are formed; it is upon the irritant action of these on the small intestine that the purgative effect depends.

DOSES.—Horses and cattle, O.i. to O.ii.; sheep and pigs, ℥ii. to ℥iv.; dogs, ℥ii. to ℥i.; foals and calves, ℥ii. to ℥iii.

Mistura Olei Ricini (*not official*).—Castor Oil, 37·5; Gum Acacia 10; Orange Flower Water of Commerce (undiluted), 15; Cinnamon Water to 100. 3 fl. dr. in 1 fl. oz.

DOSE.—For the dog, ℥ss. to ℥ii.

ACTIONS AND USES.—*Externally*, pure castor-oil is sedative and protective. A few drops applied to the conjunctiva lessen irritation after the removal of foreign bodies from the eye; it is also employed as a local application after injuries to the eye by caustic substances, such as acids or alkalis.

Internally, it is a simple purgative, and its action is not attended by griping.

Cases of poisoning by castor-oil seeds are recorded. The residue left after pressure of the seeds contains an active poison *ricin*, which does not pass into the oil, if the oil is expressed from the seeds without the assistance of heat—*i.e.*, the oil is ‘cold drawn.’

For the horse, castor-oil is an uncertain purgative, and produces extreme nausea. In foals, however, it is safe and reliable; and intestinal obstruction depending on retention of the meconium is usually treated by the administration of one wineglassful of castor-oil, repeated if necessary, and supplemented by the injection of warm-water enemata.

In cattle, castor-oil is a popular purgative agent.

In canine practice castor-oil is largely employed as a purgative. One serious objection to its use is its tendency to induce nausea and vomiting, especially when the stomach is in an irritable condition. To obviate this, emulsions of castor-oil are prescribed. In the treatment of chronic constipation castor-oil should not be employed, as after the initial purgative effect constipation recurs. In such cases liquid paraffin and cascara sagrada are more suitable.

A useful mixture is prepared by combining equal parts of castor-oil and olive-oil, and adding from 10 to 20 minims of sweet spirit of nitre, and $\frac{1}{2}$ minim of oil of peppermint or aniseed, or the **MISTURA OLEI RICINI** may be employed.

In diarrhoea in foals, calves, and dogs, a moderate dose of castor-oil is indicated as the preliminary step in treatment. In severe cases chlorodyne may be combined with the oil.

It is important that the purest form of castor-oil should be prescribed in canine practice.

Linum (Linum).—*Lini Semina*. Linseed. The dried ripe seeds of *Linum usitatissimum*, Flax, N.O. Lineæ.

Characters.—Small, brown, glossy, nearly flat, ovate, obliquely

pointed, with acute edges; 4 to 6 mm. long; glabrous, minutely pitted, yellowish-white internally, with narrow oily endosperm and two large oily cotyledons. Epidermal cells filled with mucilage; inodorous; taste mucilaginous, oily.

Composition.—The seeds contain *mucilage* and 30 to 40 per cent. of the official *fixed oil*; proteins and salts.

Linum Contusum (*Linum Contus.*).—*Lini Semina Contusa*. Crushed Linseed; Linseed Meal. Linseed reduced to a coarse powder; recently prepared.

Characters.—Familiar, odour bland; yields not less than 30 per cent. of oil to CS_2 . *Impurities*.—Starch and mineral matters (see p. 341).

Oleum Lini (*Ol. Lini*).—The oil expressed from Linseed.

Characters.—Yellowish-brown; odour characteristic, taste bland. Sp. gr. 0.930 to 0.940. Does not congeal above $-20^{\circ}C$. Thickens on exposure to air in thin layers, forming a hard transparent varnish.

Composition.—The oil contains the *glycerides* of linolic, linolenic, and isolinolenic acids with olein, stearin, palmitin, and myristin.

Doses.—Horses, Oi. to Oi.ss.; cattle, Oi.ss. to Oii.; sheep and pigs, $\frac{3}{4}$ vi. to $\frac{3}{4}$ vi.; dogs, $\frac{3}{4}$ ii. to $\frac{3}{4}$ ss.

ACTIONS AND USES.—*Externally*.—Combined with equal parts of lime-water, linseed-oil forms CARRON-OIL, which is a useful application for burns and scalds.

Internally.—In small doses linseed-oil is laxative, in full doses it is purgative. It is largely prescribed in equine practice for cases in which active cathartics would be contra-indicated. In spasmodic colic, flatulent colic, and impaction of the colon, it is administered in combination with such agents as chloral hydrate. The action of linseed-oil is uncertain, and full repeated doses may induce superpurgation and laminitis. The extreme nausea which it produces in the horse renders its employment in large or continued doses undesirable. It may be given as an enema in impaction of the colon.

Small doses are nutrient, and are usually readily taken by horses in their food:

In cattle practice, full doses of linseed-oil are prescribed in gastric affections when active or irritant cathartics are contra-indicated, but repeated doses of the oil may cause cessation of rumination, since the regurgitation of the stomach contents containing the oil proves offensive in the mouth.

Linseed-oil is frequently employed as a menstruum, to prevent the irritating effects of agents such as oil of turpentine.

Linseed-oil is unsuitable for the dog, as it tends to induce nausea, and is liable to be rejected in irritable conditions of the stomach.

It is important to remember that boiled linseed-oil, containing litharge, is used in the preparation of paints, and if it be substituted for the medicinal linseed-oil, toxic effects may be produced.

Oleum Olivæ—(see p. 335).

VEGETABLE ANTHELMINTICS.

Filix Mas (Filix Mas).—Male Fern. The rhizome of *Dryopteris Filix mas*, N. O. Filicineæ. Collected late in the autumn, divested of its roots, leaves, and dead portions, carefully dried, and kept not more than a year.

Characters.—From 7 to 15 cm. or more long, the rhizome itself from 2 to 2.5 cm. in diameter. Entirely covered with the hard, persistent, curved, angular, dark-brown bases of the petioles, which bear numerous brown, membranous scales. Petioles green internally with eight pale-yellow fibro-vascular bundles in a circle. Rhizome brown externally, green internally; transverse section, stalked secreting glands in intercellular spaces. Margins of membranous scales with two-celled projections, no glands; at the base two minute glands. Odour feeble but disagreeable; taste sweetish and astringent at first, subsequently bitter and nauseous.

Composition.—Male fern contains a yellow amorphous acid principle, *filmarone*, $C_{47}H_{54}O_{16}$; it decomposes into *filicic acid*, $C_{14}H_{18}O_5$, and *aspidinol*, $C_{12}H_{26}O_4$. *Albaspidin*, $C_{22}H_{28}O_7$, *filicitannic acid*, and *fixed oil* are also present. Filicin is an amorphous anhydride modification of filicic acid.

Extractum Filicis (Ext. Filic.).—**Extractum Filicis Liquidum.** Liquid Extract of Male Fern. An oily extract made by percolating with ether, and then evaporating or distilling off the ether. *Standardized* to contain 24 to 26 per cent. of filicin.

Doses.—Horses and cattle, $\mathfrak{z}\text{iv}$. to $\mathfrak{z}\text{i. ss.}$; sheep, $\mathfrak{z}\text{i}$. (with castor-oil, $\mathfrak{z}\text{ii}$.), or $\mathfrak{M}\text{xxx}$. repeated in twenty-four hours; dogs, $\mathfrak{M}\text{xv}$. to $\mathfrak{z}\text{i}$. Administered in emulsion with mucilage of gum acacia, and to the dog preferably in capsules.

ACTIONS AND USES.—Male fern is an anthelmintic which is especially destructive to tape-worm, and it is one of the most effectual drugs for this purpose. The administration of male fern to the dog should be preceded and followed by a saline aperient at intervals of twelve hours and six hours respectively. In the dog oleaginous purgatives such as castor-oil should be avoided during treatment, as they may dissolve the filicic acid, and thus facilitate absorption and the production of toxic effects.

When the drug is given in large doses, or under conditions which favour its absorption and retention, serious symptoms may occur in the dog. These consist in vomiting, purging, colicky pains, muscular weakness, slight convulsive seizures or muscular twitching, and occasionally blindness; death may result from collapse.

In medicinal doses, the quantity of the active constituents absorbed should be so small that no toxic symptoms arise, the major portion of the drug escaping with the fæces.

The dose for the dog should be carefully computed, having regard to the weight and physical condition of the animal. The drug is most suitably administered in capsules, and in cases in

which no vermifugal effects follow its employment the dose should not be repeated until several days have elapsed.

In the treatment of tæniasis and distomiasis in horses and cattle male fern may be combined with oil of turpentine and administered in linseed-oil, but the expense of the drug limits its application in these animals.

Male fern is of value in the treatment of distomiasis in sheep; $\frac{1}{2}$ drachm of the liquid extract is given as a draught in oil; this is repeated daily for three days. The drug destroys the parasites, which then disintegrate and are expelled from the bile-ducts. A similar line of treatment is adopted in tæniasis in sheep.

Male fern is not a safe tænicide for the cat.

Santoninum (Santonin).—Santonin; $C_{15}H_{18}O_3$. A crystalline principle which may be obtained from *santonica*, the dried unexpanded flower-heads of *Artemisia cina* and other species of *Artemisia*.

Characters.—Colourless, flat, rhombic prisms, slightly bitter, fusible and volatile when gently heated. **Solubility.**—Scarcely in water; 1 in 2.5 of chloroform; 1 in 50 of alcohol 90 per cent. Sunlight renders it yellow. Added to warm alcoholic solution of potassium hydroxide, it yields a violet-red colour. Santonin forms santonates with alkalies, from which HCl liberates santonin acid, readily reconverted into santonin.

Doses.—Horses, ʒss. to ʒi.; sheep, grs. x. to grs. xv.; pigs, grs. v. to grs. x.; dogs, gr. i. to grs. v.

ACTIONS AND USES.—Santonin is anthelmintic to round-worms, but has no effect on tape-worms. It passes through the stomach unchanged, but is fairly rapidly absorbed from the small intestine in the form of sodium santonate. Being very insoluble, the major portion is not absorbed, however, and exerts its effects on round-worms present in the intestine.

The mode of action of santonin is uncertain. The drug appears to have no lethal action upon round-worms *in vitro*, and its effect as an anthelmintic is probably due to its so affecting the parasites that they are readily removed by the purgative which follows.

Santonin is excreted by the intestines and by the kidneys, and gives a deep yellow colour to the urine when this is acid in reaction. On the addition of an alkali the urine turns red or purple in colour. A similar colour reaction may occur after the administration of chrysophanic acid in such a drug as rhubarb.

In administering santonin to dogs it is necessary to exercise caution, as excessive doses may induce toxic symptoms; these are twitching of the muscles of the head, temporary blindness, grinding of the teeth, clonic spasms, and epileptiform convulsions;

these nervous symptoms are interrupted by intervals of repose in which there occurs a curious momentary contraction of all the voluntary muscles (Cushny). Toxic doses cause irregular and insufficient respiration, and finally death from asphyxia. The antidotes are emetics and purgatives.

As santonin is not an irritant to the alimentary tract, it is prescribed for dogs when gastro-intestinal irritation is present in doses of gr. ss. to gr. i., given daily for several days.

Santonin may be administered with a mild saline aperient; this assists in the removal of the parasites, and also reduces the degree of absorption from the small intestine. It is advisable to administer another saline aperient about six hours later.

Santonin combined with other agents is effectual in eradicating round-worms from puppies, but it is not advisable to prescribe this agent in animals under eight weeks old.

Santonin, although anthelmintic to ascarids in horses, is too expensive for general use in equine practice.

Oleum Chenopodii (Ol. Chenopod.).—Oil of American Wormseed.

A volatile oil distilled from the fruit of *Chenopodium anthelminticum*, the Jerusalem oak.

It is a mixture of terpenes of which the most active is a peroxide, *ascaridole*, which constitutes about 66 per cent. of the oil. The action of the active principle deteriorates with age.

Doses.—Horses, ℥ii. to ℥iii.; pigs, ℥i. (for an animal weighing 100 pounds); dogs, ℥ii. to ℥x.; puppies, ℥ss. to ℥ii.

Chenopodium should be administered in an oleaginous purgative.

ACTIONS AND USES.—Oil of *chenopodium* is one of the most active anthelmintics against round-worms. If purgation is not secured, it is completely absorbed and is excreted in the urine, in which it is found combined with glycuronic acid.

A horse which received ℥iv. is reported to have died from enteritis within twenty-four hours. Cases have also been recorded in dogs in which deafness, in some instances of a permanent character, has followed its administration.

Oil of *chenopodium* has been found very effective in intestinal strongylosis in young horses. It is given in linseed-oil, and the treatment is preceded by a fast of thirty-six hours.

It is now apparent that much of the failure which in the past has attended the treatment of intestinal strongylosis in horses has arisen from an insufficient period of fasting before the administration of the anthelmintic, but in the case of debilitated animals the period of thirty-six hours should be shortened at the discretion of the practitioner.

Oil of chenopodium is a reliable anthelmintic for round-worms in puppies, but is distinctly toxic to cats, and for these animals it is preferable to prescribe carbon tetrachloride.

In anthelmintic treatment it is highly desirable that purgation should be effected after the anthelmintic has been administered. This is necessary to ensure the removal of the worms and also ensures the elimination from the bowel of the bulk of the anthelmintic before it can be absorbed and so reduces the risk of toxic effects.

Nux Arecæ (*not official*).—The seed of *Areca catechu*, the betel-nut tree; also known as areca-nut.

Characters.—The seeds vary in size from that of a hazel nut to that of a walnut; transverse section white, marbled with brown owing to infolding of the seed coat in the endosperm; taste astringent and slightly acid.

Doses.—Horses, $\mathfrak{z}\text{iv}$. to $\mathfrak{z}\text{i.ss}$.; dogs, grs. x. to $\mathfrak{z}\text{i.ss}$.

ARECOLINE, a colourless, volatile, liquid alkaloid, is the active principle of areca-nut. It readily forms salts, and is employed in practice as the hydrobromide (*not official*).

Doses.—Horses, gr. $\frac{1}{4}$ to gr. i.ss.; cattle, gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$; dog (by mouth), gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$.

ACTIONS AND USES.—The effect of arecoline is that of a powerful stimulant to the parasympathetic nerve-endings (see p. 60). This results in a marked increase in the motor activity of the stomach and intestines; in augmentation of salivary, bronchial, and gastro-intestinal secretion; in contraction of the bronchi; in slowing of the heart-rate, and in contraction of the pupil, but the last-mentioned effect is transient and slight.

Arecoline is principally used as a purgative and vermifuge; the vermifuge action probably depends upon the increased peristalsis and outpouring of intestinal secretion.

When injected hypodermically arecoline produces free purgation in fifteen to thirty minutes, and because of the rapidity of its action it proves a valuable agent in equine practice when immediate purgative effects are desired; thus it is frequently employed in colic due to intestinal impaction, in which condition it is a valuable remedial agent, but its employment in colic is governed by the same considerations as those which apply to physostigmine.

Its prompt purgative action renders it a valuable agent in laminitis and in myoglobinuria. It is sometimes desirable to give small doses (gr. $\frac{1}{4}$) repeated as circumstances indicate at intervals of one hour.

The purgative action of arecoline is erratic in cattle, but doses

of gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$ (hypodermic) are advised in impaction of the rumen.

Powdered areca-nut is largely employed as a vermifuge for both tape- and round-worms in the dog. The dose is computed on the basis of 2 grains for each pound of the animal's weight.

Areca-nut should be freshly ground; it is insoluble in water, but may be administered as a suspension in milk. For the eradication of tapeworm it is advisable to combine the areca-nut with a half-dose of the extract of male fern.

Areca-nut is unsafe for puppies under six months of age, and is contra-indicated in cases of incipient distemper and catarrhal enteritis.

Areca-nut is unsafe for cats, as it may cause an outpouring of bronchial mucus to such a degree that suffocation results; kamala is preferable for this animal.

As an anthelmintic for tape-worm in the dog, Hall advises gr. $\frac{1}{2}$ to gr. $\frac{1}{4}$ of arecoline hydrobromide given as a draught. No purgative is required, the drug being itself purgative.

One per cent. solutions may be employed as collyria when it is desired to produce myosis and reduce intra-orbital pressure.

ANTIDOTE.—Atropine depresses the parasympathetic nerve-endings and is the specific antidote to arecoline.

Kamala (*not official*) consists of the minute glands and hairs obtained from the surface of the fruits of *Mallotus philippinensis*.

It possesses general anthelmintic and purgative actions, and is principally employed for the eradication of tape-worm in cats in doses of grs. x. to grs. xv.; dogs, grs. xxx. to $\mathfrak{z}\text{ii}$. It is usually given mixed with syrup.

A fluid extract of kamala is prepared commercially, and is a convenient form in which to administer the drug.

Pelletierinæ Tannas (Pellet, Tann).—Pelletierine Tannate. A mixture of the tannates of the alkaloids obtained from the bark of the stem and root of the *Punica granatum*, the pomegranate, N.O. Lythraceæ.

Characters.—A light-yellow amorphous powder. **Solubility**.—Slightly in water, more in alcohol 90 per cent. No odour; taste astringent.

Composition.—Pomegranate bark contains *punicotannic acid*, $\text{C}_{20}\text{H}_{16}\text{O}_{12}$; three liquid alkaloids—*pelletierine*, or *punicine*, $\text{C}_8\text{H}_{15}\text{NO}$, *isopelletierine*, and *methyl-pelletierine*, $\text{C}_9\text{H}_{17}\text{NO}$; and a crystalline alkaloid, *pseudopelletierine*, $\text{C}_9\text{H}_{15}\text{NO}, 2\text{H}_2\text{O}$. **Incompatibles**.—Alkalies, lime-water, metallic salts.

Pelletierine has little action on round-worms, but is a powerful tænicide. It remains undissolved in the stomach, but is slowly dissolved and absorbed in the small intestine. Pelletierine is given to the fasting dog in doses of 4 grains suspended in water; this is followed two hours later by a dose of castor-oil.

CUSO, BUTEA, and EMBELIA also possess anthelmintic actions, but they are seldom employed in veterinary practice, and do not merit consideration here.

THE TANNIC ACID ASTRINGENTS.

Tannic acid is astringent in virtue of its power to precipitate proteins and gelatin. Tannin substances are contained in a large number of plants. These tannins, while not identical chemically, all possess similar pharmacological actions. Tannic acid also precipitates alkaloids, some glucosides, and the salts of the heavy metals. Solutions of pepsin and peptone are also precipitated, but not in an acid medium.

When tannic acid is administered by mouth, it forms protein tannate with the undigested proteins in the stomach. The protein tannate is then digested, and in the process tannic acid is liberated. This can again precipitate undigested proteins, but has no effect on the peptones in the acid stomach. A similar action occurs in the intestine, but if the stomach and bowels be relatively empty, the tannic acid coagulates the superficial layers of the gastro-intestinal mucous membrane. In this way an astringent effect is produced; the layer of coagulated protein acts as a protective and lessens the irritability of the mucous membrane. It also decreases the secretion of intestinal mucus, and so retards the passage of the intestinal contents.

Tannic acid is largely converted into gallic acid in the intestine, and although only a small proportion is excreted in the fæces, the remainder appears to be rapidly oxidized in the tissues and exerts no pharmacological action after absorption. Tannic acid therefore exerts only a local astringent action on the alimentary tract.

Galla.—Galls (*not official*). Excrescences on *Quercus infectoria*, N.O. Cupuliferæ, resulting from the presence of the larvæ of *Cynips gallæ tinctoriæ*.

Characters.—Hard, heavy, subglobular; from 12 to 18 mm. or more in diameter; smoothly tuberculated; dark bluish-green or dark olive green externally; yellowish or brownish-white within, with a

small central cavity; sink in water and show no perforation; no odour; taste intensely astringent.

Composition.—Gallo-tannic acid, 50 to 70 per cent.; small amounts of gallic acid, ellagic acid, sugar and starch.

Unguentum Gallæ (*not official*).—Galls, 20; Benzoated Lard, 80.

Unguentum Gallæ cum Opio (*not official*).—Gall Ointment, 92·5; Opium, 7·5. Contains 7·5 per cent. of opium.

Acidum Tannicum (Acid. Tann.).—Tannic Acid; Tannin; $C_{13}H_8O_7$ ·COOH.

Source.—May be extracted by water-saturated ether from galls which have been subjected to a special fermentation.

Characters.—A light-brownish powder consisting of thin glistening scales; odour characteristic; taste strongly astringent; reaction acid.

Solubility.—1 in 1 of water, or of alcohol 90 per cent.; 1 slowly in 1 of glycerin. *Incompatibles.*—Gelatin (which it precipitates yellowish-white, distinguishing it from gallic acid); mineral acids; alkalis; salts of antimony, lead, silver, and other heavy metals; ferric salts, giving a bluish-black colour; most alkaloids; vegetable emulsions.

Doses.—Horses, 3ss. to ʒii.; dogs, grs. ii. to grs. v.

Glycerinum Acidi Tannici (Glycer. Acid. Tann.).—15 in 100. Warm gently and dissolve by trituration.

Acidum Gallicum—Gallic Acid (*not official*).

Source.—May be prepared from galls or by the hydrolysis of tannic acid.

Characters.—White or pale brown silky needles, no smell; soluble 1 in 100 of cold water, 1 in 3 of boiling water, and 1 in 10 of glycerin.

Doses.—Similar to those of tannic acid.

ACTIONS AND USES—*Externally.*—The principal external use of tannic acid is in the treatment of burns and scalds. For this purpose it is now employed in the form of a 25 per cent. aqueous solution; this must be freshly prepared. To the solution of tannic acid, acriflavine is sometimes added in the proportion of 1 in 1,000; powders containing appropriate amounts of tannic acid and acriflavine may be kept ready to dissolve in a sufficient quantity of water to form a solution of the desired strength. Tannic acid jelly, which consists of tannic acid and a soft paraffin base, may be kept in closed containers and is ready for immediate use in an emergency. Tannic acid acts by precipitating the protein in the damaged tissue, and by forming a dense leathery coagulum protects the tissue from the entrance of pyogenic organisms and also prevents the absorption of the products of tissue destruction; in this way sepsis and secondary shock are prevented. Tannic acid applied to abrasions of the skin or to mucous surfaces constricts the tissues, diminishes the local circulation, and slightly reduces the sensibility of the nerve-endings.

The Glycerinum Acidi Tannici is sometimes employed as an

astringent application in moist eczematous eruptions. A similar combination is used as an application in relaxed conditions of the pharynx met with in canine practice.

The gall and opium ointment is employed as a local application in the treatment of painful conditions of the anal region in the dog.

Internally.—The action of tannic acid on the stomach and intestines is described above. Tannic acid itself is seldom prescribed internally, agents containing it, such as catechu and kino, being preferred as intestinal astringents.

Tannic acid has no action as a styptic in internal hæmorrhage.

Tannic acid acts as an *antidote to alkaloids* by forming insoluble tannates; but unless these be promptly evacuated by emetics in the dog and by purgatives in the horse, the toxic principles become liberated; the antidote is therefore only a temporary one.

TANNALBIN (*not official*) is a combination of tannic acid and albumin; it is unaffected by the gastric juice, but is decomposed slowly in the intestine, liberating tannic acid; thus the possibility of gastric irritation is avoided.

In doses of 20 to 40 grains it has been employed in diarrhoea and dysentery in foals and calves, being repeated three times daily. Dogs may be given grs. v. to grs. xv.

TANNIGEN (*not official*), a compound of tannin with acetic acid, has similar actions and uses to tannalbin. It is employed in intestinal catarrh in foals, the dose being grs. xxx.

TANNOFORM (*not official*)—See p. 207.

Catechu (Catech.).—Catechu; Catechu Pallidum. An extract of the leaves and young shoots of *Uncaria gambier*, N.O. Rubiaceæ.

Characters.—Cubes, separate or agglutinated, about 25 mm. square; dark reddish-brown externally, and pale cinnamon-brown internally; porous, friable; microscopically presenting myriads of acicular crystals. No odour; taste bitter, very astringent, then sweetish. *Solubility.*—Almost entirely in boiling water; not less than 70 per cent. in alcohol 90 per cent.

Composition.—Catechu chiefly contains a crystalline bitter substance, *catechin* or *catechuic acid*, $C_{15}H_{14}O_6 \cdot 4H_2O$, probably inactive; 36 per cent. of *catechu-tannic acid*, the active principle; *catechu-red*, $C_{36}H_{24}O_{15}$; and *gambier-fluorescein*. Both acids give a green precipitate with ferric salts. *Incompatibles.*—Alkalies, metallic salts, and gelatin. *Purity.*—Starch.

Doses.—Horses, ʒi. to ʒii.; cattle, ʒii. to ʒvi.; sheep and pigs, ʒss. to ʒi.; dogs, grs. v. to grs. xv.

Tinctura Catechu (Tinct. Catech.).—Catechu; Cinnamon Bark; Alcohol 45 per cent.; by maceration.

Doses.—Horses, ʒi. to ʒii.; dogs, ℥x. to ʒi.

Pulvis Catechu Compositus (*not official*).—Catechu, 40; Kino, 20; Krameria, 20; Cinnamon, 10; Nutmeg, 10.

Doses.—Horses, ʒiii. to ʒvi.; dogs, grs. x. to grs. xx.

ACTIONS AND USES.—Catechu is a powerful astringent, resembling tannic acid in its actions. It is prescribed in persistent diarrhoea and in dysentery, especially in horses and cattle, being combined with prepared chalk and a carminative such as powdered ginger. In severe cases opium may be added with benefit; the mixture is best administered in well-boiled flour-gruel.

Kino.—Kino (*not official*). The juice obtained from incisions in the trunk of *Pterocarpus marsupium*, N.O. Leguminosæ, heated to boiling and evaporated to dryness. Known in commerce as East Indian, Malabar, Madras, or Cochin kino.

Characters.—Small, angular, glistening, opaque, reddish-black, brittle fragments, transparent and ruby-red in thin laminæ; inodorous; taste very astringent, tinging saliva red. **Solubility.**—Partially in water; not less than 75 per cent. in boiling water; almost entirely in alcohol 90 per cent.

Composition.—Kino contains 75 per cent. of kino-tannic acid, $C_{18}H_{18}O_8$, giving a greenish precipitate with ferric salts of iron; *pyrocatechin*, a derivative of catechin; *kino-red*, formed from kino-tannic acid by oxidation; and *gum*. **Incompatibles.**—Mineral acids, alkalies, carbonates, metallic salts, and gelatin.

Doses.—Similar to those of catechu nigrum.

Pulvis Kino Compositus (*not official*).—Kino, 75; Opium, 5; Cinnamon Bark, 20. Contains 5 per cent. opium.

Dose.—Dogs, grs. v. to grs. xv.

Tinctura Kino (*not official*).—Kino, 10; Glycerin, 15; Water, 25; Alcohol 90 per cent. to 100; by maceration.

Dose.—Dogs, ℥xv. to ʒss.

ACTIONS AND USES.—The actions and uses of kino are similar to those of catechu; it is prescribed as an astringent in obstinate diarrhoea in the dog.

Krameria (Kramer.).—Rhatany Root. The dried root of *Krameria triandra*.

Krameria contains *Rhatania Tannic Acid* and resembles catechu in its actions. It is one of the components of compound catechu powder, but is seldom prescribed alone.

Cinnamomum (Cinnam.).—Cinnamomi Cortex; Cinnamon Bark. The dried inner bark of shoots from truncated stocks of *Cinnamomum zeylanicum*. Obtained from cultivated trees. Imported from Ceylon, and distinguished in commerce as Ceylon cinnamon. N.O. Laurinæ.

Characters.—Closely rolled quills, each about 9 mm. in diameter, containing smaller quills; thin, brittle, splintery; dull pale yellowish-brown externally, with small scars or holes and faint shining wavy lines; darker brown within. Odour fragrant; taste warm, sweet, aromatic. *Impurity*.—Cassia bark; rougher, thicker, less aromatic, starchy.

Composition.—Cinnamon bark contains the official *volatile oil*, *tannic acid*, and *mucilage*.

Oleum Cinnamomi (Ol. Cinnam.).—The oil distilled from Cinnamon Bark.

Characters.—Yellow when recent, becoming reddish; odour and taste of cinnamon bark. Sp. gr. 1.000 to 1.030. *Solubility*.—1 in 3 or 4 of alcohol 70 per cent.

Composition.—Contains *cinnamic aldehyde*, $C_6H_5 \cdot C_3H_3 \cdot CHO$, 50 to 60 per cent., and *cinnamic acid*, $C_6H_5 \cdot CH \cdot CH \cdot COOH$, as well as benzoates. *Impurities*.—Cinnamon leaf oil and cassia oil, giving blue or brown coloration with ferric chloride instead of pale green.

Dose.—Dog, ℥i. to ℥iv. in syrup or mucilage.

Tinctura Cinnamomi (*not official*).—20 in 100 of Alcohol 70 per cent.; by percolation.

Dose.—Dog, ℥xv. to ʒi.

ACTIONS AND USES.—Cinnamon combines the actions of the volatile oils and tannic acid, and therefore possesses carminative, astringent, aromatic, stimulant, and antiseptic properties. The oil and the tincture of cinnamon are prescribed for diarrhoea in the dog.

Hæmatoxyli Lignum.—Logwood (*not official*). The heartwood of *Hæmatoxylon campechianum*, N.O. Leguminosæ.

Characters.—Hard, heavy; externally dull orange to purplish-red, internally reddish-brown. The chips and the coarse powder (unfermented and with no green metallic lustre) have a feeble agreeable odour and a sweetish astringent taste, colouring the saliva reddish-violet when chewed.

Composition.—Logwood contains *tannic acid*, and 10 per cent. of a peculiar colouring principle, *hæmatoxylin*, $C_{16}H_{14}O_6 \cdot 3H_2O$, in colourless crystals, which become red on exposure to air; solutions turn yellow to orange with acids, purple with alkalis; and coagulate gelatin. The decoction precipitates ferric salts, violet blue, lead acetate and other metallic salts a beautiful blue. *Incompatibles*.—Mineral acids, metallic salts, lime-water, and tartar emetic.

Decoctum Hæmatoxyli (*not official*).—Logwood, 5; Cinnamon Bark, 1; Water to 100.

Doses.—Horses and cattle, ʒvi. to ʒviii.; dogs, ʒii. to ʒi.

ACTIONS AND USES.—Logwood is an astringent. It is occasionally prescribed in obstinate diarrhoea in cattle, and in dysentery. In combination with dilute sulphuric acid and infusion of cloves it is useful in obstinate diarrhoea in the dog.

Logwood colours the fæces and urine a dark red.

Hamamelis (Hamam.).—*Hamamelis*; *Hamamelidis Folia*; *Hamamelis Leaves*; *Witch Hazel Leaves*. The leaves, fresh or dried, of *Hamamelis virginiana*.

Characters.—Broadly oval in outline, from 7 to 15 cm. long. Upper surface dark green or brownish-green, under surface paler; apex obtuse, margin sinuate; narrowed towards the base, oblique, slightly cordate, shortly petiolate; veins pinnate, prominent on the under surface, furnished with stellate hairs. Odour not marked; taste astringent, slightly bitter.

Composition.—The leaves contain *tannic acid*; *gallic acid*; a bitter principle; and a volatile oil.

Extractum Hamamelidis Liquidum (Ext. Hamam. Liq.).—The dried leaves in Alcohol 45 per cent.; by percolation.

Dose.—Dogs, ℥v. to ℥xv.

Unguentum Hamamelidis (*not official*).—Liquid Extract, 10; Wool Fat, 60; Soft Paraffin, 30.

Hamamelidis Cortex.—*Hamamelis Bark*; *Witch-Hazel Bark* (*not official*). The dried bark of *Hamamelis virginiana*, N.O. *Hamamelideæ*.

Characters.—Curved or channelled pieces, 5 to 20 cm. long, 1.5 mm. thick; sometimes with silvery-grey scaly cork; otherwise externally reddish-brown, smooth; internally pale reddish-pink, striated; fracture fibrous, laminated; odour not marked; taste astringent.

Composition.—*Tannic acid*, 6 per cent.; with *gallic acid*, *resin*, etc.

Tinctura Hamamelidis (*not official*).—*Hamamelis Bark*, 10; Alcohol, 45 per cent. to 100; by percolation.

Dose.—Dogs, ℥x. to ℥xxx.

ACTIONS AND USES.—*Hamamelis* possesses astringent and hæmostatic actions when applied locally, but it has no remote action. The ointment is a useful application for anal irritation in the dog.

Chrysarobin.

Chrysarobinum (Chrysarob.).—*Chrysarobin*. A mixture of pure chrysarobin, $C_{15}H_{12}O_3$, with other substances extracted from araroba by hot benzene.

Characters.—A light, micro-crystalline, yellowish powder, inodorous, tasteless. *Solubility*.—Entirely in hot chloroform and in hot benzene, almost entirely in hot alcohol 90 per cent., partially in petroleum spirit; almost insoluble in water.

Composition.—Consists of a chemical substance known as chrysarobin, with *dichrysarobin*, *dichrysarobin methyl ether*. Chrysarobin, $C_{15}H_{12}O_3$, is converted into *chrysophanic acid*, $C_{15}H_{10}O_4$, by slow oxidation.

Unguentum Chrysarobini (Ung. Chrysarob.).—*Chrysarobin* in Unguentum Simplex (4 per cent.).

ACTIONS AND USES.—*Chrysarobin* is a parasiticide, and the ointment is employed in the treatment of ringworm. It is also useful in chronic psoriasis, but is liable to produce much irritation of the skin.

Ipecacuanha.

Ipecacuanha (Ipecac.).—**Ipecacuanha Root.** The dried root of *Psychotria ipecacuanha*, N.O. Rubiaceæ.

Characters.—Somewhat tortuous pieces, seldom more than 15 cm. long or 6 mm. thick; dark brick-red to very dark brown; closely annulated externally, the annulations not taking the form of narrow raised ridges (distinction from *Cartagena ipecacuanha*). Fracture short, exhibiting a thick greyish bark and small dense wood. Odour slight; taste bitter. Yields not less than 2 per cent. of alkaloids.

Composition.—Ipecacuanha contains three alkaloids: *emetine*, $C_{28}H_{37}(CH_3)N_2O_4$, about 2 per cent., amorphous, white, but turning yellow, comparatively insoluble in water, forms soluble but unstable salts; *cephaeline*, $C_{28}H_{38}N_2O_4$, more powerfully emetic than emetine, about 1 per cent.; and *psychotrine*; a glucosidal acid, *ipecacuanhic acid*, $C_{14}H_{18}O_7$; calcium oxalate and starch.

Ipecacuanha Pulverata (Ipecac. Pulverat.) contains 2 per cent. of alkaloids.

DOSES OF POWDERED IPECACUANHA.—Horses, \mathfrak{z} i. to \mathfrak{z} i.ss.; dogs, gr. $\frac{1}{4}$ to grs. ii.; as an emetic, grs. xv. to \mathfrak{z} ss.

Extractum Ipecacuanhæ Liquidum (Ext. Ipecac. Liq.).—Alcoholic 90 per cent. *Standardized* to contain 2 per cent. of alkaloids calculated as emetine.

DOSE.—Horses, \mathfrak{z} ss. to \mathfrak{z} i.; dogs, \mathfrak{M} ss. to \mathfrak{M} ii.; as an emetic, \mathfrak{M} x. to \mathfrak{M} xxx.

Tinctura Ipecacuanhæ (Tinct. Ipecac.).—Liquid Extract of Ipecacuanha, 5; Alcohol (90 per cent.); Glycerine; Distilled Water to 100.

DOSES.—Horses, \mathfrak{z} ii. to \mathfrak{z} i.; dogs, as an expectorant, \mathfrak{M} v. to \mathfrak{z} ss.; as an emetic, \mathfrak{z} iii. to \mathfrak{z} vi.

INCOMPATIBLES.—Lead and mercury salts, vegetable acids, astringent infusions.

Pulvis Ipecacuanhæ et Opii (Pulv. Ipecac. et Opii).—Dover's Powder. Ipecacuanha Root; Opium; Lactose. A light fawn-coloured powder (see p. 230).

DOSES.—Horses, \mathfrak{z} i. to \mathfrak{z} iv.; dogs, grs. v. to grs. xv.

ACTIONS AND USES.—*Externally*, ipecacuanha is an irritant to the skin and mucous membranes.

Internally.—Emetine, the chief alkaloid of ipecacuanha, is a powerful irritant to all mucous surfaces, and ipecacuanha, when given by mouth, irritates the gastric and intestinal mucous membrane, causing purgation, and in the dog emesis also.

It was believed that the emetic effect was partly of central origin, but, although vomiting follows the subcutaneous injection of emetine hydrochloride, larger quantities are required to produce this effect than are necessary when the drug is given by mouth. The interval between administration and vomiting is longer in the case of subcutaneous injection. Vomiting does not

follow subcutaneous injection of emetine if the vagus has been previously divided. It would therefore appear that the drug is wholly local in its emetic action, and that the emesis following subcutaneous injection is due to the drug's excretion into the stomach. The emetic action is slow, and the emesis, which may not be produced for twenty or thirty minutes, is accompanied by considerable nausea and depression. Ipecacuanha increases the secretion from the bronchial mucous membrane, and renders it more fluid, thus acting as an expectorant. This effect depends on a reflex action from irritation of the stomach, and upon stimulation of the bronchial mucous membrane during the drug's elimination. The diaphoretic action of ipecacuanha which occurs in man is not observed in animals.

EMETINE is prescribed as a gastric stimulant for horses and cattle in the form of emetine hydrochloride or hydrobromide administered subcutaneously in a dose of grs. iii. to grs. vi.

Emetine in large doses is an irritant poison, producing gastro-enteritis and collapse. When repeated in sub-toxic doses, it produces a cumulative action.

While emetine may be regarded as a specific in amoebic dysentery in man, the manner of its action is uncertain. Experiment has shown that concentrations of the drug higher than could be tolerated by the bowel are required to kill amœbæ. It is possible that its effect in amoebic dysentery may in part be due to its raising the resistance of the intestinal mucosa to attack by the parasites.

Although the precise manner in which the drug exerts beneficial effects in dysentery in the dog is not known, it may be that it acts by destroying low forms of animal life, such as amœbæ, to which some forms of dysentery in animals may be due. Certainly there can be no question as to its value. The drug may be conveniently administered to the dog in the form of BISMUTH EMETINE IODIDE, in doses of $\frac{1}{8}$ gr. to $\frac{1}{2}$ gr. given in salol-coated pills to avoid solution in the stomach. It is repeated daily, but its cumulative action is to be remembered.

As an expectorant, ipecacuanha is prescribed in acute and chronic bronchitis when the bronchial secretion is thick and scanty, and for such cases in the dog it may be combined with the syrup of squills. It is not a suitable emetic in cases of poisoning in the dog, because of its slow action, but its emetic action is useful in acute bronchial affections when the upper air-passages become blocked by the secretion, as the act of vomiting tends to remove the obstructing mucus.

In small doses ipecacuanha is distinctly anti-emetic, and in persistent vomiting in dogs is occasionally prescribed as the

tincture (M $\frac{1}{8}$ to M $\frac{1}{4}$) given in a little ice-water and repeated half-hourly.

Dover's powder is prescribed in the early stages of catarrhal affections in the dog, and is sometimes useful in dysentery in this animal and in the intestinal form of distemper.

Agropyrum.

Agropyrum.—Triticum; 'Couch Grass' (*not official*). The dried rhizome of *Agropyron repens*, N.O. Gramineæ.

Characters.—Rhizome pale yellow, rigid, 2 to 2.5 mm. in diameter; usually in pieces 3 to 6 mm. long; strongly furrowed longitudinally; hollow except at the nodes; no odour; taste slightly sweet. Contains no starch.

Composition.—Contains *tritacin*, a carbohydrate; *glucose*; *mannite*; *inosite* and *mucilage*.

Extractum Agropyri Liquidum (*not official*).—Couch Grass, 1; boiled in 10 of Water for half an hour; Alcohol 90 per cent. added after evaporation to make 1.

Dose.—Dog, ʒi. to ʒii.

ACTIONS AND USES.—Triticum possesses a mild diuretic action, and also allays irritation of the urinary passages. It is prescribed for the dog in cystitis and urethritis. It may be remarked that the natural instinct of the dog leads him to seek for and to ingest couch grass. Triticum is not known to exert any effects on the stomach or intestines.

Cherry-Laurel.

Laurocerasi Folia.—Cherry-Laurel Leaves (*not official*). The fresh leaves of *Prunus laurocerasus*, N.O. Rosaceæ.

Characters.—Thick, coriaceous, on short strong petioles; oblong or somewhat obovate; 12 to 18 cm. long; tapering towards each end, recurved at apex; distantly but sharply serrate and slightly revolute at margins; dark green, smooth, and shining above, much paler beneath; midrib prominent, and at the base one or two glandular depressions. When bruised they emit an odour like bitter almonds.

Composition.—Cherry-laurel leaves contain a bitter crystalline glucoside, *laurocerasin* (prulaurasin), $C_{14}H_{17}NO_8$, a glucoside of racemic mandelonitrile ($C_6H_5.CH.CN.OH$), which is in the leaf parenchyma; and an enzyme, *prunase*, present in the endodermis of the veins. By hydrolysis of the glucoside, benzaldehyde, hydrocyanic acid, and dextrose are formed: $C_{14}H_{17}NO_8 + H_2O = C_6H_5.CHO + HCN + C_6H_{12}O_6$.

Aqua Laurocerasi.—Cherry-laurel Water (*not official*). 80 in 100 by distillation, and *standardized* by the addition either of water or of hydrocyanic acid, so that the strength is 0.1 per cent. of HCN, as tested volumetrically with $AgNO_3$. **Incompatibles.**—Metallic salts.

ACTIONS AND USES.—Cherry-laurel is a gastric sedative, but is seldom employed for this purpose.

The water is chiefly used as a local sedative for the eye, and it forms an adjunct to eye-lotions, the strength being 1 or 2 parts in 16.

Cinchona and Quinine.

Cinchona (Cinchon.).—*Cinchonæ Rubræ Cortex.*—Red Cinchona Bark; 'Bark.' The dried bark of the stem and branches of cultivated plants of *Cinchona* sp., N.O. Rubiaceæ.

Characters.—Quilled or curved pieces; from 5 to 30 cm. or more long; 2.5 to 6 mm. thick; cork brownish or reddish-brown; with longitudinal ridges, and sometimes reddish warts; inner surface brick-red or deep reddish-brown, irregularly and coarsely striated. Fracture fibrous. Powder brownish or reddish-brown. No marked odour; taste bitter, somewhat astringent.

(Salts of quinine may also be obtained from various other species of cinchona.)

Composition.—Cinchona barks contain (1) four important *alkaloids*—namely, *quinine*, *cinchonine*, *quinidine*, and *cinchonidine*; (2) two *peculiar acids*, *kinic* and *kinovic* acids; (3) a variety of tannic acid called *cincho-tannic acid*; (4) *cinchona red*; and (5) traces of an aromatic volatile oil.

Incompatibles.—Ammonia, lime-water, metallic salts, and gelatin. May be combined with mineral acids.

DOSES OF POWDERED CINCHONA BARK.—Horses, ʒii. to ʒss.; cattle, ʒi.; dogs, grs. v. to grs. xxx.

Tinctura Cinchonæ (Tinct. Cinchon.).—Extract of Cinchona, 10; Alcohol 70 per cent. to 100; by percolation. *Standardized* to contain 1 per cent. of total alkaloids.

DOSES.—Horses, ʒi. to ʒii.; dogs, ℥xv. to ʒi.

Tinctura Cinchonæ Composita (Tinct. Cinchon. Co.).—Compound Tincture of Cinchona; Extract of Cinchona, 50; Dried Bitter Orange Peel; Serpentry Rhizome; Cochineal; Alcohol 70 per cent. to 1,000; by maceration. *Standardized* to contain 0.5 per cent. of total alkaloids.

DOSES.—Similar to those of the tincture of cinchona.

Quininæ Sulphas (Quinin. Sulph.).—Quinine Sulphate $(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 7\frac{1}{2}H_2O$. The sulphate of an alkaloid, quinine, obtained from the bark of various species of cinchona.

Characters.—Small, light, silky, white crystals; no odour; taste intensely bitter. **Solubility.**—1 in 800 of water, imparting to it a fluorescent blue; 1 in 65 of alcohol 90 per cent.; entirely in water acidulated with a mineral acid. Solution of ammonia gives with solutions a white precipitate of quinine, soluble in ether. With bromine or chlorine solution and a drop of strong solution of ammonia, quinine solutions give a deep green coloration (thalleioquin). In mixtures, 1 min. of a diluted mineral acid will dissolve 1 grain.

Sixty grains require 60 minims of diluted sulphuric acid for solution in 2 ounces of distilled water.

DOSES.—*As a bitter tonic:* horses, ʒss. to ʒi.; cattle, ʒi. to ʒii.; sheep and pigs, grs. v. to grs. xv.; dogs, gr. ss. to grs. ii. *As an antipyretic:* horses, ʒi. to ʒi.ss.; cattle, ʒii. to ʒiii.; dogs, grs. ii. to grs. v.

Quininae Hydrochloridum (Quinin. Hydrochlor.).—Quinine Hydrochloride, $C_{20}H_{24}N_2O_2 \cdot HCl \cdot 2H_2O$. The hydrochloride of an alkaloid, quinine, obtained from the bark of various species of cinchona.

Quininae Dihydrochloridum (Quinin. Dihydrochlor.).—Acid Quinine Hydrochloride; $C_{20}H_{24}N_2O_2 \cdot 2HCl$. The acid hydrochloride of an alkaloid, quinine, obtained from the bark of various species of cinchona.

Characters.—A white amorphous powder; no odour; taste very bitter. *Solubility*.—1 in less than 1 of water; solution acid.

This is suitable for intramuscular injection in canine practice.

Dose.—For dogs, gr. ss. to grs. ii. in 20 parts of distilled water.

Liquor Quininae Ammoniatum (Liq. Quinin. Ammon.).—Ammoniated Tincture of Quinine; Quinine Sulphate, 2; Solution of Ammonia, 10; Alcohol 60 per cent., 88.

The preparation when mixed with water throws down a precipitate, and if it is desired to dispense it with water, it is necessary to add mucilage of acacia to the mixture.

Dose.—For dogs, ℥xx. to 3ss.

ACTIONS—*Externally*.—Quinine is injurious to all forms of living matter, and thus in being a general protoplasmic poison it possesses powerful antiseptic and disinfectant actions. Because of its toxic action on protoplasm, subcutaneous and intramuscular injection cause considerable pain and may result in abscess formation.

Internally.—Quinine is a powerful bitter, and by thus stimulating the gustatory nerves salivation is produced and gastric secretion and peristalsis increased. This stomachic effect is obtained by the repeated administration of the drug in small doses. (It is said that a single medicinal dose may considerably inhibit the secretion of gastric juice in the dog.)

All salts of quinine are converted in the stomach into the dihydrochloride, which is readily absorbed in the duodenum.

The Blood.—Quinine at first increases but later arrests the movements of leucocytes; diapedesis is therefore inhibited and the occurrence of suppuration may be prevented. Oxyhæmoglobin is rendered more stable; hence the oxygen exchange in the blood is diminished.

Quinine, by destroying the causal protozoa, is a specific in human malaria.

Temperature and Metabolism.—In the normal animal, quinine may cause a slight initial rise of temperature, succeeded by a considerable fall; but if given in febrile conditions, the fall in temperature is much more marked. It was believed that quinine probably lowered temperature by diminishing nitrogenous metabolism and limiting heat production, but there is now

evidence that quinine has no influence on protein metabolism, but that it directly acts upon the heat-regulating centre, causing an increase in heat loss. In specific fevers its antipyretic effect may be in part due to its toxic action upon the causal organisms.

Circulatory and Respiratory Systems.—Medicinal doses of quinine have no appreciable effect upon the circulation or respiration; toxic doses, however, are markedly depressant to both cardiac and respiratory action.

The Uterus.—Quinine, by acting directly on the muscle of the uterus, excites uterine contractions. Experience of its employment in pregnant animals indicates that it does not exert any important abortifacient action.

Excretion.—Excretion is effected almost entirely by the kidneys. Quinine is slowly eliminated from the body, the excretion of a single dose requiring a period of about forty-eight hours; but excretion in the urine begins in fifteen minutes, and the greater portion is eliminated within twenty-four hours after administration. About 40 per cent. of the drug is excreted, the remaining 60 per cent. being broken down in the tissues. Large doses may produce gastro-intestinal irritation and vomiting in dogs.

Derangements of the sense of hearing and of sight, which sometimes occur in man as the result of full doses of quinine, are not observed in animals.

MEDICINAL USES—Externally.—Quinine is not used as a surgical antiseptic.

Internally.—As a bitter tonic, quinine is prescribed in small doses in atonic indigestion, and in convalescence from debilitating diseases.

As an antipyretic, quinine is largely employed in febrile affections. The reputation of quinine in malarial fever of man has led to its employment in a large number of specific diseases, but there is little evidence of its value in bacterial infections. Its antipyretic effect is prolonged, and there is less risk of depression or collapse than is the case with such antipyretic agents as acetanilide and sodium salicylate. It is given either in bolus or as a draught, the addition of a little dilute sulphuric acid being necessary to render the sulphate soluble when prescribed in solution. It should be given in moderate doses repeated at intervals.

In 'red-water' in cattle the administration of quinine in doses of from 2 to 4 drachms three times daily was recommended, but its value here is doubtful.

H. Gray recommended the administration of the acid hydro-

chloride of quinine, by intramuscular injection, in the early stages of canine typhus.

The ammoniated tincture of quinine is useful in canine practice, in cases in which such a stimulant as ammonia is indicated in combination with the quinine.

Cinchona bark contains tannin, and is somewhat astringent. It is prescribed as a tonic stomachic when an astringent effect also is desirable, and for this purpose is usually combined with other tonic agents.

Salicylic acid.

Acidum Salicylicum (Acid. Salicyl.).—Salicylic Acid; $C_6H_4.OH.CO_2H$.

Source.—Obtained (1) from natural salicylates, such as the oils of wintergreen (*Gaultheria procumbens*, N.O. Ericaceæ) and sweet birch (*Betula lenta*, N.O. Amentaceæ); or (2) by the interaction of sodium phenate and carbon dioxide.

Characters.—Distinct, prismatic, colourless crystals. Taste at first sweetish, then acid, leaving a burning sensation in the throat. *Solubility*.—1 in about 500 of water; 1 in 3.5 of alcohol 90 per cent.; 1 in 2 of ether; dissolves in solutions of ammonium citrate, ammonium acetate, and of sodium phosphate. Solutions give a violet colour with Fe_2Cl_6 solution; the acid dissolved in excess of Na_2CO_3 solution and shaken with ether, the ethereal residue is free from odour of phenol. M.p. 156° to 157° C.; volatilizes without decomposition. *Incompatible* with spiritus ætheris nitrosi and iron salts.

Doses.—Horses and cattle, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$.; sheep and pigs, grs. xx. to grs. xl.; dogs, grs. v. to grs. xv.

Unguentum Acidi Salicylici (Ung. Acid. Salicyl.).—2 per cent. in paraffin ointment.

Sodii Salicylas (Sod. Salicyl.).—Sodium Salicylate; $C_6H_4.OH.COONa$.

Source.—May be obtained by the interaction of salicylic acid and sodium carbonate.

Characters.—Small colourless scales, or tabular crystals having a pearly lustre; inodorous; taste sweetish, unpleasant, saline. *Solubility*.—1 in less than 1 of water, but solution on standing may deposit crystals of the salt with 6 mols. of water of crystallization; 1 in 6 of alcohol 90 per cent.; solutions neutral or faintly acid. Solutions give violet colour with Fe_2Cl_6 solutions.

Doses.—Horses, $\mathfrak{z}\text{ss}$. to $\mathfrak{z}\text{i}$. ($\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$. in acute muscular rheumatism); dogs, grs. x. to $\mathfrak{z}\text{ss}$.

Bismuthi Salicylas (see p. 151).

Salicinum (Salicin.).—Salicin; $C_6H_{11}O_5.O.C_6H_4.CH_2OH$. A crystalline glucoside which may be obtained from the bark of various species of *Salix* and of *Populus*, N.O. Salicineæ.

Characters.—Colourless, shining, trimetric tabular crystals, or white crystalline powder; taste very bitter. *Solubility*.—1 in 28 of water; 1 in 80 of alcohol 90 per cent.; insoluble in ether. H_2SO_4 colours it red. Heated with K_2CrO_4 , CrO_3 , a few drops of H_2SO_4 ,

and some water, it yields salicylic aldehyde, having the odour of meadow-sweet.

Doses.—Horses, $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{iii}$.; dogs, grs. v. to grs. xv.

Acidum Acetylsalicylicum (Acid. Acetylsalicyl.).—Acetylsalicylic acid; 'Aspirin'; $\text{C}_6\text{H}_4(\text{COOH})\text{OCOCH}_3$.

Source.—Obtained by the action of acetic anhydride or of acetyl chloride on salicylic acid.

Characters.—A white crystalline, inodorous powder; taste slightly acid. *Solubility*.—Sparingly in water; 1 in 5 of alcohol 90 per cent.; soluble in ether. M.p. 133° to 135° C. Boiled with NaOH and neutralized by dilute H_2SO_4 , salicylic acid is formed. Aqueous solution gives no violet colour with Fe_2Cl_6 solution.

Doses.—Horses, $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iii}$.; dogs, grs. v. to grs. x.

ACTIONS.—*Externally*, salicylic acid possesses antiseptic actions at least equal to those of carbolic acid, and the salicylates also are antiseptic. Both the acid and the salicylates retard or prevent the putrefaction of protein solutions and the alcoholic and acetic acid fermentations.

Salicylic acid, if applied to the skin in a concentrated form, causes softening of the horny cells, which become loosened and separated from the corium without the occurrence of inflammatory changes; it is thus keratolytic.

Internally.—Salicylic acid is absorbed very rapidly, and circulates in the blood in the form of salicylate of soda, which in the liver is combined with glycuronic acid and the greater part of the salicylate is excreted as salicyl-glycuronic acid or as its salts.

After a single dose administered by mouth, excretion in the urine commences in about fifteen minutes, and rapid excretion continues for about forty hours (Clark).

In herbivoræ even large doses do not produce any appreciable toxic effects beyond temporary dyspepsia, but in the dog toxic doses of salicylic acid are irritant, and may cause vomiting (partly of central origin), dyspnoea, weakness of the hind-quarters, and convulsions, succeeded by paralysis. Irritation of the kidneys, albuminuria, and occasionally hæmaturia, may also be observed.

It was generally believed that salicylic acid depressed the heart to a dangerous degree, but it appears to have no direct action as a cardiac depressant.

The salicylates, being less irritant, are preferred for internal administration.

The salicylates are said to possess a slight direct cholagogue action, increasing both the amount and solids of the bile. They increase the excretion of urea and uric acid as the result of increased nitrogenous metabolism.

Salicylates have no effect on the temperature of healthy animals; but in febrile conditions they cause a marked fall of temperature. The nature of the antipyretic action is not clearly understood.

MEDICINAL USES—*Externally*.—Salicylic acid 11 parts, extract of cannabis indica 2 parts, collodium flexile 87 parts, is used in the treatment of warts.

Salicylic acid as a stimulant and antiseptic is applied to wounds (1 in 500) or as an ointment 1 in 25. In eczema it may be used as a dusting powder with zinc oxide 1 in 20.

Internally.—The salicylates are commonly used in the treatment of acute muscular rheumatism, but beneficial effects are not always observed in veterinary practice. This is probably due to the insufficiency of the doses usually prescribed. Todd has shown that doses of 4 ounces of salicylate of soda may be given safely and with benefit to horses suffering from rheumatism, while smaller doses prove useless. The action of the salicylates in rheumatism is still obscure.

Quitman advises salicylic acid in the treatment of gastric tympany in the horse. He administers ʒss. of the drug combined with ʒii. of powdered ginger in the form of capsule, and repeats the dose in one-half to one hour if necessary. Clinical reports upon the value of this treatment are conflicting.

Salicylate of soda in the early stages of pachymeningitis in the dog allays the pain and nervous irritability.

The salicylates are recommended in the treatment of cystitis, and bismuth salicylate, combined with tannic acid, has been found useful in obstinate diarrhoea in calves.

Sodium salicylate is frequently given in specific febrile conditions, such as canine distemper and equine influenza, but, apart from its action as a febrifuge, it is of very doubtful value.

SALICIN closely resembles the salicylates in its action. It is occasionally given to the dog as a bitter stomachic.

ACETYL-SALICYLIC ACID.—ASPIRIN passes unchanged through the stomach and consequently produces no gastric irritation. It is absorbed from the alkaline duodenum. Aspirin is now largely employed in canine practice as an antipyretic. It appears to reduce 'nervous tension,' and is distinctly anodyne. It has largely replaced the salicylates in the treatment of acute rheumatic affections.

Oleum Gaultheriæ.—Oil of Gaultheria; Oil of Wintergreen (*not official*). The oil distilled from the leaves of *Gaultheria procumbens*, N.O. Ericaceæ, or from the bark of the sweet birch, *Betula lenta*, N.O. Betulaceæ.

Characters.—Colourless, or nearly so; odour strong, characteristic;

taste pungent. Sp. gr. 1.180 to 1.187. *Solubility*.—1 in 6 of alcohol 70 per cent.

Composition.—Contains not less than 99 per cent. of esters, calculated as *methyl salicylate*; also a *ketone* and an odorous *ester*.

Oil of gaultheria is rapidly absorbed through the skin. It stimulates but later depresses the sensory nerve-endings; it is thus a mild rubefacient and anodyne. These actions depend largely upon the methyl salicylate which it contains. It may be used as a 10 per cent. ointment with lanolin as a local application in acute muscular rheumatism in the dog.

Methylis Salicylas (Methyl. Salicyl.).—Methyl Salicylate; Methyl Ester of Salicylic Acid; $C_6H_4(OH)COOCH_3$.

Source.—Obtained by the interaction of methyl alcohol and salicylic acid.

Characters.—A colourless liquid; odour characteristic, aromatic; taste sweetish, warm, aromatic. *Solubility*.—Slightly in water; readily in alcohol 90 per cent. (solution neutral or slightly acid), in glacial acetic acid and in carbon disulphide. Sp. gr. 1.185 to 1.192. B.p. 219° to 221° C. Optically inactive. Aqueous solution gives violet colour with Fe_2Cl_6 solution.

Methyl salicylate may be employed for the same purpose as oil of gaultheria.

Yohimbine (Aphrodine) (*not official*).

Yohimbine is an alkaloid obtained from the bark of the yohimbe tree (*Corynanthe yohimbi*). It is used in therapeutics in the form of yohimbine hydrochloride.

Doses.—Stallions, gr. 1; bulls, grs. 1½; cows, grs. 1½; sheep, gr. ½; small dogs, gr. ¼ to gr. ¾; large dogs, gr. 1; administered in the food or drinking water three times daily. Tablets containing the requisite doses are prepared commercially.

ACTIONS AND USES.—Yohimbine in medicinal doses is an aphrodisiac, and is employed in functional impotence in the male and in sexual frigidity in the female. It is not cumulative in its action, and does not cause irritation of the urinary organs. It produces a marked vascular dilatation in the genital organs, resulting in considerable swelling and turgidity. The lumbar centres governing the act of copulation are stimulated, and the quality of the sexual reflexes is improved. The drug is said to be a respiratory stimulant by direct action upon the respiratory centre. Care in assessing the dose is requisite especially in canine practice.

The *toxic symptoms* recorded are dyspnoea, cardiac depression, purgation, salivation, convulsions, partial paralysis.

It is now recognized that sexual impotence and sterility are

very commonly due to causes other than lack of sexual desire; consequently such aphrodisiacs as yohimbine have a very limited application.

Fibrolysin (*not official*).

Fibrolysin, a liquid composed of thiosinamine and salicylate of soda. Thiosinamide is obtained by heating oil of mustard with ammonia and alcohol.

ACTIONS AND USES.—Fibrolysin causes a local inflammatory reaction at the site of old fibrous deposits, and is said to have the power of breaking them up and facilitating their absorption. It may be employed in the treatment of any condition depending upon the presence of a chronic fibrous deposit. Fibrolysin is injected intramuscularly, the dose for the horse being 11.5 c.c. The injections are repeated daily or at intervals of two or three days, according to the requirements of the case. Sterile glass ampullæ are prepared containing the requisite dose. Further experience of this compound suggests that it is of very limited value.

Cotton-Wool.

Gossypium.—Cotton; Cotton-wool (*not official*). The hairs of the seeds of *Gossypium herbaceum*, N.O. Malvaceæ, and of other species of *Gossypium*, freed from fatty matter.

Characters.—Long white soft filaments, each consisting of an elongated cell, under the microscope appearing as a flattened twisted band with slightly thickened rounded edges; inodorous and tasteless. Readily wetted by water without yielding either an alkaline or an acid reaction. Soluble in ammoniacal solution of copper oxide.

Composition.—Cellulose.

Absorbent cotton-wool is extensively employed for surgical dressings.

EMOLLIENTS, DEMULCENTS.

Oleum Olivæ (Ol. Oliv.).—Olive Oil. The oil expressed from the ripe fruit of *Olea europæa*, N.O. Oleaceæ; and refined.

Characters.—Pale or greenish-yellow, odour faint, taste bland. Sp. gr. 0.915 to 0.918; at 10° C. often becomes pasty.

Composition.—Olive oil consists of 72 per cent. of fluid oils: *olein*, $C_3H_5(C_{17}H_{33}COO)_3$, and *linolein*; and 28 per cent. of solid oils, *palmitin*, $C_3H_5(C_{15}H_{31}COO)_3$, and *arachin*. These are compounds of a radical, *glyceryl*, C_3H_5 , with *oleic acid*, $C_{17}H_{33}COOH$, and *palmitic acid*, $C_{15}H_{31}COOH$ respectively.

DOSES.—As a laxative it is prescribed in canine practice in doses of ʒss. to ʒi.

ACTIONS AND USES.—*Externally.*—Olive-oil is an emollient. It is largely employed as a basis for liniments, and combined with carbonate of potash and water it forms an emulsion

which is useful as an application to blistered surfaces (see Appendix, p. 502).

A mixture of equal parts of lime-water and olive-oil forms the LINIMENTUM CALCIS.

Internally.—Olive-oil is a mild laxative and demulcent, and also possesses nutrient properties. It is employed as an enema in intestinal obstruction. As a demulcent, it is given in cases of poisoning by irritants, but should not be used in cases of phosphorus poisoning (see p. 161).

Sapo Durus (Sap. Dur.).—Hard Soap; "Castile Soap"; Sodium Oleate.

Source.—Made from olive-oil and sodium hydroxide, $C_3H_5(C_{17}H_{33}COO)_3 + 3NaOH = 3C_{17}H_{33}COONa + C_3H_5(OH)_3$. Contains not more than 30 per cent. of water (see Olive-Oil, p. 335).

Characters.—Greyish-, yellowish-, or greenish-white; nearly inodorous; horny and pulverizable when dried. *Solubility.*—Soluble in alcohol 90 per cent.; 1 in 20 of cold, and 1 in 1.5 of hot water.

Sapo Mollis (Sap. Moll.).—Soft Soap; Potassium Oleate; $C_{17}H_{33}COOK$.

Source.—Made from olive-oil and potassium hydroxide (see Olive-Oil, p. 335).

Characters.—Yellowish-white to green, almost inodorous, unctuous. *Solubility.*—Readily soluble in alcohol 90 per cent.

Linimentum Saponis (Lin. Sap.).—Soft Soap, 8; Camphor, 4; oil of Rosemary, 1.5; Water, 17; Alcohol 90 per cent. to 100.

Sapo Animalis (Sap. Animal.).—Curd Soap; Sodium Stearate; $C_{17}H_{33}COONa$.

Source.—Made from sodium hydroxide and purified animal fats consisting principally of stearin; contains not more than 30 per cent. of water.

Characters.—Yellowish- or greyish-white; nearly inodorous; horny and pulverizable when dried, plastic when heated. *Solubility.*—Soluble in alcohol 90 per cent.; sparingly in cold, but completely in hot water; solution being neutral or faintly alkaline.

ETHER SOAP (*not official*)—

Dissolve 32 parts of soft soap in 20 parts of alcohol (90 per cent.). Allow the solution to stand for twenty-four hours, filter, and then add methylated ether (specific gravity, 0.720), 52 parts (see also p. 501).

ACTIONS AND USES.—Soaps are detergent, and are employed for the cleansing of the skin. A solution composed of equal parts *sapo mollis* and methylated spirits (B.P.) forms an excellent fluid dog soap. This preparation is in itself a powerful antiseptic, but the addition of suitable antiseptics and parasitocides may be of advantage.

Several proprietary soaps containing adequate amounts of

active antiseptics are valuable for the purpose of cleansing and disinfecting the hands and arms of the surgeon.

Soap added to enemata increases their laxative action. As an emetic for the dog, in an emergency, soap and water may be administered until emesis is induced.

Soap liniment is employed as a mild stimulating application, and also as a basis in the preparation of other liniments. Both hard and soft soaps are used in the preparation of pills and boluses.

Glycerinum (Glycer.).—Glycerin; Glycerol. A trihydric alcohol, $C_3H_5(OH)_3$, associated with a small percentage of water.

Source.—Obtained by hydrolysis of fats and fixed oils by means of alkalies or superheated steam.

Characters.—A clear, colourless, hygroscopic, syrupy liquid, without odour; taste sweet, followed by a sensation of warmth; miscible with water and alcohol 90 per cent.; neutral; insoluble in ether, chloroform, and fixed oils. When decomposed by heat it evolves intensely irritating vapours. Sp. gr. 1.260. It is the trihydroxyl derivative, or alcohol, of a hydrocarbon radical glyceryl, C_3H_5 , which, in combination with fatty acids, forms fixed oils. It is separated in the hydrated form when oils are decomposed by alkaline hydrates (*saponification*), or by water (hydrogen hydrate) at high temperatures; and is thus a by-product in making soaps.

Suppositorium Glycerini (Supp. Glycer.).—Suppository of Glycerin. Contains gelatin 14 per cent., glycerin 70 per cent., and water.

ACTIONS AND USES.—*Externally.*—Glycerin is markedly hygroscopic, and if applied undiluted is slightly irritant to the skin and mucous membrane. It also possesses antiseptic properties, and when diluted with 2 parts of water, it is demulcent and emollient.

As a solvent, glycerin is extensively employed in pharmacy, its combinations with drugs being termed 'glycerina'—example, *Glycerinum Acidi Boraci*.

Internally.—In moderate doses, glycerin is laxative in the dog.

As a sweetening agent it may be added to mixtures containing nauseous or bitter-tasting drugs. It is employed in the preparation of electuaries, and it exerts beneficial local demulcent effects in pharyngitis and laryngitis.

Glycerin enemata elicit local irritation of the rectal mucosa, and so reflexly induce evacuation of faeces from the colon; for this purpose $\frac{1}{2}$ ounce, either alone or with the addition of one-third part of water, is employed to unload the lower bowel in the dog. From 4 to 8 ounces may be used for the horse.

Glycerin suppositories are useful in canine practice in effecting rapid and easy evacuation of the bowel.

Acidum Oleicum (Acid. Oleic.).—Oleic Acid; Hydrogen Oleate; $\text{CH}_3(\text{CH}_2)_7\text{CH}:\text{CH}(\text{CH}_2)_7\text{COOH}$, or $\text{C}_{17}\text{H}_{33}\text{COOH}$.

Source.—Obtained by the saponifying action of alkalies and subsequent action of acids, or by the action of superheated steam upon commercial oleins.

Characters.—A straw-coloured liquid; odour occasionally faintly rancid. Sp. gr. 0.890 to 0.910. It becomes semi-solid below 9°C .

Solubility.—Insoluble in water; readily soluble in alcohol 90 per cent., chloroform and ether.

Oleic acid dissolves metallic oxides forming oleates, which are held in solution in excess of the acid.

Oleic acid readily penetrates the skin, and is occasionally added to ointments and liniments when a penetrative action is desired.

Sucrosum (Sucros.).—*Saccharum Purificatum*. Refined Sugar; Sucrose; $\text{C}_{12}\text{H}_{22}\text{O}_{11}$. A crystallized sugar obtained from the juice of the sugar cane, sugar beet, and other plants.

Characters.—Familiar. *Solubility*.—2 in 1 of water. It increases the solubility of lime in water. *Impurities*.—Glucose, alkaline earths, chlorides, sulphates.

Syrupus (Syr.).—Refined Sugar, 1; Water, 1.5; dissolve with the aid of heat. Sp. gr. 1.330.

Refined sugar or syrup is contained in all the official syrups and in many other preparations.

Sugar is nutritive and demulcent, but is principally employed as a vehicle for other drugs.

Lactosum (Lactos.).—*Saccharum Lactis*. Milk Sugar; Lactose; $\text{C}_{12}\text{H}_{22}\text{O}_{11}\cdot\text{H}_2\text{O}$. A crystallized sugar from whey of milk.

Characters.—A white powder or crystalline masses; odourless; faintly sweet. *Solubility*.—1 in 7 of cold, in about 1 of boiling water.

Impurities.—Excess of lactic acid, sucrose. *Substance resembling Milk Sugar*.—Acid potassium tartrate; known by taste.

Milk sugar is principally used as a diluent and vehicle for powders.

Glucosum Liquidum (Glucos. Liq.).—Liquid Glucose. A syrupy mixture of dextrose and analogous substances.

Source.—Obtained by hydrolysis of starch.

Characters.—Very viscous, almost colourless; no odour; taste sweetish. *Solubility*.—Freely in water; solution, dextro-rotatory, gives a red precipitate if warmed with potassio-cupric tartrate.

Impurities.—Water, sulphites, arsenic.

ACTIONS AND USES.—Glucose is a normal constituent of the blood and is a rapidly absorbed and assimilated nutrient. It is

given in shock and collapse, and proves valuable as a protective of the liver when administered before severe operations involving prolonged chloroform anæsthesia. In ketosis, such as is associated with post-parturient dyspepsia in cows and pregnancy toxæmia in ewes, glucose should be given preferably with insulin (see p. 356).

DOSES.—*By Intravenous Injection*.—For horses and cattle, 1 litre of a 20 to 40 per cent. solution; for dogs, 30 to 50 c.c. of a 20 per cent. solution.

By Intramuscular Injection.—For dogs, 10 to 100 c.c. of a 10 per cent. solution may be injected according to the size of the animal.

By Subcutaneous Injection.—For horses and cattle, up to 1½ litres of a 15 per cent. solution.

By Rectal Injection.—10 per cent. solutions are injected up to the maximum amount that can be retained.

By the Mouth.—Glucose may be administered *ad libitum*.

Theriaca.—Treacle (*not official*).

The uncrystallisable residue obtained in the process of refining sugar. Characters well known.

DOSE.—For cattle, lb. i. to lb. ii.

ACTIONS AND USES.—Treacle is demulcent, nutritive, and laxative. It is frequently used in cattle practice, forming a valuable adjunct to saline purgatives, increasing their action and masking their nauseous taste.

Treacle forms a convenient vehicle for the administration of such drugs as chloral hydrate that are likely to cause irritation of the mouth and throat, and it makes an excellent basis for electuaries.

Tragacantha (*Tragacanth*).—*Tragacanth*. A gummy exudation, obtained by incision from *Astragalus gummifer*, and some other species. Known as Syrian tragacanth in commerce. N.O. Leguminosæ.

Characters.—Thin, white, or pale yellowish-white, flattened flakes, frequently 2.5 cm. long and 12 mm. wide; irregularly oblong or curved; marked with concentric ridges. Somewhat translucent and horny; fracture short; inodorous; almost tasteless. **Solubility**.—Sparingly in water, but swells into a gelatinous mass, which tinges violet or blue by iodine solution. **Impurities**.—Other gums. *Substance resembling Tragacanth*.—Squill, which is thicker and opaque.

Composition.—*Tragacanth* consists of two gums: *tragacanthin* (*bassorin*), $C_{12}H_{20}O_{10}$, 33 per cent., unfermentable, comparatively insoluble in water, but forming with it a colloidal gel; and a gum nearly identical with the *arabin* of acacia (but precipitated by lead acetate), 53 per cent., soluble in water (see p. 109). It also contains starch.

Mucilago Tragacanthæ (*Mucil. Tragacanth*).—Powdered *Tragacanth*, 1.25; Alcohol 90 per cent., 2.5; Chloroform Water to 100.

Pulvis Tragacanthæ Compositus (Pulv. Tragacanth. Co.).—Powdered Tragacanth, 15; Gum Acacia, 20; Starch; Refined Sugar, 45.

ACTIONS AND USES.—Tragacanth possesses demulcent actions. It is chiefly used for the suspension of heavy insoluble powders, such as bismuth salts in mixtures, and for the emulsification of oils. Either the mucilage or the compound powder may be employed for these purposes, but emulsions made with the compound powder of tragacanth are liable to ferment.

It is also employed as a vehicle for irritant drugs.

Acacia (Acac.).—Gum Acacia. A gummy exudation from the stem and branches of *Acacia senegal*, and of other species of acacia, N.O. Leguminosæ.

Characters.—Rounded or ovoid tears or masses, nearly colourless, or with a yellowish tint, opaque from numerous minute cracks, brittle, with vitreous fracture, or angular fragments with glistening surfaces. Nearly inodorous; taste bland and mucilaginous. **Solubility.**—Insoluble in alcohol 90 per cent.; entirely soluble in water, yielding a faintly acid colloidal solution. **Incompatible** with alcohol, borax, acids, ferric salts, lead subacetate. **Impurities.**—Starch, dextrin, tannic acid, sugars, mineral matters.

Composition.—Gum acacia consists chiefly of *arabic acid*, or *arabin*, $C_{10}H_{20}O_{10} \cdot H_2O$, united with calcium, magnesium, and potassium; two sugars, *arabinose* and *galactose*; and 12 per cent. of water.

Mucilago Acaciæ (Mucil. Acac.).—Gum, 4; in Chloroform Water, 6; recently prepared.

Three drachms of the mucilage are usually required to emulsify \mathfrak{z} i. of oil. It should be freshly prepared, as it is liable to undergo acetous fermentation.

Injectio Sodii Chloridi et Acaciæ (see p. 116).

ACTIONS AND USES.—Gum acacia, in the form of mucilage, has actions and uses similar to those of tragacanth.

Agar (Agar).—Agar-agar. Japanese isinglass.

Source.—The dried, sliced stem obtained from various seaweeds.

Characters.—Occurs in the form of transparent flakes and as a white powder. Consists of a carbohydrate, *gelose*. Insoluble in cold, but soluble in hot water.

ACTIONS AND USES.—Agar absorbs water and increases in bulk. It increases the fluidity and bulk of the intestinal contents, and so acts as a mechanical laxative.

Dose.—Dogs, \mathfrak{z} ss. to \mathfrak{z} ii.

Glycyrrhiza (Glycyrrh.).—Glycyrrhizæ Radix. Liquorice Root. The peeled root and peeled subterranean stem of *Glycyrrhiza glabra*, and other species, N.O. Leguminosæ.

Characters.—Long, nearly cylindrical, pale-yellow pieces, with a fibrous surface and coarsely fibrous fracture. Transverse sections exhibit a thick bark with radiating groups of bast fibres and calcium oxalate cells; and a porous, radiate, yellow wood. Powdered root, pale yellow with many bast fibres. Odour faint, characteristic; taste sweet, free from bitterness. *Substances resembling Liquorice Root*.—Pyrethrum and taraxacum, which are not sweet.

Composition.—Liquorice root contains *grape-sugar, glycyrrhizin, starch, resin, asparagin, and proteins*. Glycyrrhizin is a white crystalline substance consisting of the K and Ca salts of glycyrrhizic acid, $C_{44}H_{63}NO_{18}$; it is not a glucoside.

Pulvis Glycyrrhizæ Compositus (Pulv. Glycyrrh. Co.).—Liquorice; Senna Leaves; Fennel; Sublimed Sulphur; Refined Sugar.

ACTIONS AND USES.—Liquorice root possesses demulcent and expectorant actions, and is chiefly used as a basis in preparing electuaries.

COMPOUND LIQUORICE POWDER is occasionally employed as a laxative for the dog in habitual constipation, and may be administered in doses of ʒi.

Linum (Linum).—Linseed; Flax Seed.

The dried ripe seeds of *Linum usitatissimum* N.O. Linæ.

Linum Contusum.—Crushed Linseed; Linseed Meal (see p. 313).

Oleum Lini.—See p. 313.

LINSEED-TEA is prepared by boiling linseed in 15 or 20 parts of water until the grains are soft.

ACTIONS AND USES.—*Externally*, linseed is employed in the form of poultices (see p. 97) prepared with 4 parts of linseed meal and 10 parts of boiling water, the meal being mixed gradually with the water and constantly stirred.

Internally.—Linseed is demulcent and nutritive. Linseed-tea is largely used as a demulcent for horses or cattle in irritable conditions of the throat, alimentary canal, kidneys, and bladder.

Linseed and linseed cakes are largely employed as feeding-stuffs for cattle.

Hordeum Decorticatum.—Pearl Barley (*not official*).

Decoctum Hordei.—Barley-water (*not official*).

One part of barley boiled in 15 parts of water for twenty minutes and then strained.

ACTIONS AND USES.—Barley-water is nutrient and demulcent; it is a useful adjunct in the treatment of irritable conditions of the bladder and urinary passages, the animal being permitted to drink it *adlibitum*.

In the rearing of foals, when it is found necessary to substitute cow's milk for that of the dam, the addition of barley-water assists digestion.

Farina Triticæ—Wheaten Flour (*not official*). The grain of wheat (*Triticum sativum*) ground and sifted.

ACTIONS AND USES.—Wheaten flour is used medicinally in the treatment of diarrhoea and superpurgation, being administered in the form of flour-gruel in combination with astringents.

Amylum (Amylum).—Starch. The starch procured from the grains of maize, *Zea mays*; N.O. Gramineæ.

Characters.—In fine powder or in irregular, angular, or columnar masses, readily reduced to powder; white; inodorous. Cold water mixed with an equal weight of starch does not become more than faintly acid or alkaline to litmus. Boiled with water and cooled, it gives a deep blue colour with solution of iodine. Microscopically: (1) *Wheat Starch*: A mixture of large and small granules, the former lenticular, marked with faint concentric striæ surrounding a nearly central hilum. (2) *Maize Starch*: Granules more uniform in size, frequently polygonal, somewhat smaller than the large granules of (1), with a very distinct hilum but no evident concentric striæ. (3) *Rice Starch*: Granules extremely minute, nearly uniform in size, polygonal, without evident hilum or striæ. **Impurity.**—Potato starch.

ACTIONS AND USES.—*Externally*, starch is protective, absorbent, and desiccant, and forms a basis for surgical dusting-powders.

Boiled to form a stiff paste, it is used to stiffen bandages for surgical purposes. Cold starch paste is also employed as a poultice.

Starch paste is a valuable deodorant, and if gently rubbed into the skin of the hand and arm of the surgeon before and after handling putrid material—such as retained bovine placenta—it will effectually remove the abominable and persistent odour.

Internally.—Starch possesses demulcent and astringent actions, and in the form of starch mucilage or gruel it is employed in diarrhoea and dysentery. Starch mucilage is prepared by triturating ℥ii. of starch with water, which is gradually added up to ℥x. in amount. It is then boiled for two or three minutes, during which time it is constantly stirred.

It is an efficient antidote in iodine-poisoning, forming the insoluble iodide of starch.

Extractum Malti (Ext. Malt.).—Extract of Malt. A syrupy yellowish-brown fluid, with a sweet taste; made by acting on malt, or

a mixture of malt and flour, by water at a temperature not exceeding 55° C.

Composition.—Malt extract consists chiefly of *maltose*; *dextrin*; *albumins*, including an active ferment *diastase*; and the soluble phosphates of the barley. Good specimens will convert several times their bulk of starch into sugar.

ACTIONS AND USES.—Malt is prescribed as a restorative in debility and in dyspepsia, as the diastase which it contains converts starch into sugar. Various preparations of malt in combination with tonics, cod-liver oil, etc., are prepared commercially, and are suitable for use in canine practice. A special 'horse malt' is also prepared, which can be administered either in the food or in electuary.

Oleum Theobromatis (Ol. Theobrom.).—Oil of Theobroma; Cacao Butter; Cocoa Butter. A solid fat expressed from the roasted seeds of *Theobroma cacao*, N.O. Sterculiaceæ.

Characters.—A yellowish-white solid; odour like that of cocoa; taste bland and agreeable; fracture smooth. Sp. gr. 0.990 to 0.998. Softens at 25° C., and melts at 30° to 33° C.

Composition.—Oil of theobroma constitutes from 30 to 50 per cent. of cacao bean, with an alkaloid *theobromine*, $C_7H_8N_4O_2$. It consists chiefly of stearin, palmitin, and laurin.

Cacao butter melts below body temperature, and is used as a basis for suppositories and pessaries.

GROUP IX—THE ANIMAL KINGDOM.

Lanolin.

Adeps Lanæ (Adeps Lan.).—Wool Fat; Anhydrous Lanolin. The purified fat of sheep's wool, freed from water.

Characters.—Yellowish, tenacious, unctuous; nearly inodorous. M.p. about 40° C.

Composition.—Contains the alcohols *cholesterol* and *ischolesterol*, with *esters* and various *fatty acids*.

Adeps Lanæ Hydrosus (Adeps Lan. Hydros.).—Lanolin. Wool Fat, 70; Water, 30.

Unguentum Lanæ Compositum.—Emollient Ointment (*not official*) Wool Fat, 40; Prepared Lard, 40; Paraffin Ointment, 20.

ACTIONS AND USES.—Hydrous wool fat or lanolin is an emollient, and is chiefly used as a basis for ointments. It does not become rancid, and water can be incorporated with it without affecting its ointment consistency.

Lanolin is readily absorbed by the skin, and when used as a basis for parasiticide agents in the treatment of sarcoptic scabies, skin penetration is assisted; as a basis for blisters, it is superior to lard or soft paraffin.

It is advisable to combine a small amount of soft paraffin or lard with the lanolin in order to render it less tenacious and so facilitate its application; for this reason the unguentum lanæ compositum is often used as an ointment base.

Lanolin is an excellent dressing for weak and brittle hooves in the horse; for this purpose a less refined and less expensive form is employed.

Lard.

Adeps (Adeps).—*Adeps Præparatus*. Prepared Lard. The purified internal fat of the hog, *Sus scrofa*.

Characters.—A soft, white, homogeneous, unctuous substance; odour faint, not rancid. Dissolves entirely in ether. M.p. 38° to 40° C. Contains no vitamin A.

Composition.—Lard consists of 60 per cent. of *olein* and *stearin*, with some *palmitin*. Olein, $C_3H_5(C_{18}H_{33}O_2)_3$, is a *fluid* oil, a compound of oleic acid, $C_{18}H_{32}O_2$, and glyceryl, C_3H_5 . Palmitin and stearin are *solid* oils, compounds of glyceryl with palmitic acid, $HC_{16}H_{31}O_2$, and stearic acid, $HC_{18}H_{25}O_2$.

Adeps Benzoinatus (Adeps Benz.).—Benzoinated or Benzoated Lard. Prepared Lard, 100; Benzoin, 3.

ACTIONS AND USES.—Lard is a simple emollient. It is frequently employed as a basis for ointments when it is desired that the active ingredient penetrate the skin. Benzoated lard does not become rancid.

Suet.

Sevum (Sev.).—*Sevum Præparatum*. Prepared Suet. The purified internal fat of the abdomen of the sheep, *Ovis aries*.

Characters.—Firm, white, unctuous, almost odourless; taste bland; m.p. 45° to 50° C.

Composition.—Suet contains 70 to 80 per cent. of *stearin* and *palmitin*, with 20 to 30 per cent. of *olein*. Contains vitamin A.

Sevum Benzoatum.—Benzoated Suet (*not official*). Prepared Suet, 100; Benzoin, 3; by heating.

In India, prepared suet or benzoated suet should be used in making the preparations for which prepared lard or benzoated lard respectively is directed to be used.

ACTIONS AND USES.—Suet is a simple emollient; combined with lanolin, it is commonly used as a dressing for brittle hooves in the horse. Benzoated suet does not become rancid.

Spermaceti.

Cetaceum.—Spermaceti (*not official*). A solid wax obtained from the sperm whale, *Physeter macrocephalus*, and possibly other species.

Characters.—Pearly white, glistening, translucent, with a leafy crystalline structure, slightly unctuous to the touch; with little odour. Sp. gr. 0.950 to 0.960; m.p. 46° to 50° C. Powdered by addition of a little alcohol 90 per cent. Soluble in 50 of hot alcohol 90 per cent.

Composition.—Spermaceti is a fat, *cetin*. $C_{16}H_{33}.C_{15}H_{31}COO$, containing not glyceryl but *cetylic alcohol*, $C_{16}H_{33}OH$, in combination with *palmitic acid*, $C_{15}H_{31}COOH$.

Unguentum Cetacei (*not official*).—Cetaceum, 20; White Beeswax, 8; Liquid Paraffin, 72.

ACTIONS AND USES.—Spermaceti is emollient and demulcent; it is sometimes employed as an application to blistered surfaces and irritable conditions of the skin. It is also used in the preparation of ointment bases.

Oleum Cetacei—Sperm-Oil (*not official*)—is used as a basis for parasiticide dressings for horses and cattle.

Beeswax.

Cera Flava (Cera Flav.).—Yellow Beeswax.

Source.—Obtained from the honeycomb of the hive bee, *Apis mellifica*.

Characters.—A yellowish-brown solid; somewhat brittle when cold, becoming plastic in the hand; fracture granular; odour agreeable, honey-like. **Solubility.**—Soluble in chloroform and in fixed and volatile oils. Sp. gr. 0.958 to 0.970; m.p. 61° to 64° C.

Composition.—Wax differs from ordinary fats in containing, as its base, not glyceryl but another alcohol, *melissyl alcohol*, $C_{30}H_{61}OH$, united with palmitin to form *melissyl palmitate* (myricin), $C_{15}H_{31}COOC_{30}H_{61}$, 80 per cent.; free *cerotic acid*, $C_{26}H_{53}COOH$; an aromatic body, *cerolein*; and *melissyl stearate*.

Cera Alba (Cera Alb.).—White Beeswax; Yellow Beeswax bleached.

Characters.—Hard, nearly white, translucent.

USES.—Beeswax is chiefly used to increase the consistence of ointments and plasters. It forms a useful constituent of the various forms of hoof dressings for horses.

Unguentum Aquosum (see p. 220).

Honey.

Mel Depuratum (Mel. Depur.).—Purified Honey. Honey of commerce, melted and strained, the sp. gr., if necessary, being adjusted to 1.36 by addition of water.

ACTIONS AND USES.—Honey is demulcent, laxative, and nutritive. It is chiefly employed as a constituent of electuaries.

Gelatin.

Gelatinum (Gelatin).—Gelatin. The air-dried product of the action of boiling water on animal tissues such as skin, tendons, ligaments, and bones.

Characters.—Translucent, almost colourless sheets or shreds.
Solubility.—Soluble in water and in acetic acid; insoluble in alcohol 90 per cent. and ether. A solution in 50 parts of hot water is inodorous, and solidifies to a jelly on cooling. Aqueous solution is precipitated by solution of tannic acid; not by diluted acids, or solutions of alum or of lead acetate, or solution of ferric chloride.

Uses.—Gelatin is chiefly used in pharmacy for coating boluses and pills, for the preparation of capsules, and as a basis for pessaries and suppositories.

Keratin.

Keratin (*not official*) is prepared by steeping horn parings in a mixture of pepsin 4, hydrochloric acid 1, and water 95 parts, as long as anything passes into solution. The insoluble residue is then dissolved in ammonia by lengthy maceration and evaporated to syrupy consistence.

Uses.—Keratin being insoluble in the gastric juice, but soluble in the intestinal secretions, is employed to coat boluses and pills, which are intended to act in the intestine but not in the stomach. Thus certain anthelmintics which tend to cause gastric irritation may be administered in keratin capsules. Drugs, such as intestinal antiseptics and astringents, when it is desired that they should exert their local action solely on the intestine, may also be administered in this way.

Ichthyol.

Ichthammol (Ichtham).—Ichthyol. Ammonium Ichthosulphonate. Prepared from bituminous schists which are largely composed of the remains of fish and other marine animals. A brown viscid liquid, soluble in water, glycerin, and fats; partly in alcohol.

ACTIONS AND USES.—Ichthyol is a local vascular sedative, a parasiticide, and an antiseptic. If applied to a raw surface or to inflamed skin, it causes at first a sensation of smarting; this is succeeded by a feeble local anæsthetic and astringent action.

Ichthyol is applied in the treatment of chronic affections of the skin, such as eczema and psoriasis. It is advised in the treatment of parasitic skin affections, and as a local application in erysipelas and in rheumatic arthritis. For these purposes it is employed in the form of ointment containing a lanolin basis (strength 2 to 10 per cent.).

Cod-Liver Oil.

Oleum Morrhuae (Ol. Morrh.).—Cod-liver Oil. The oil extracted from the fresh liver of the cod, *Gadus morrhua*, the solid fat having been separated by filtration at about 0° C.

Characters.—Pale yellow; odour slight, fish-like, not rancid; taste bland, fish-like. Sp. gr. 0.920 to 0.930. **Impurities.**—Inferior oils.

Composition.—(1) Cod-liver oil consists chiefly of *jecolein* and *therapin*, glycerides of jecoleic acid, $C_{19}H_{36}O_2$, and therapeutic acid, $C_{17}H_{34}O_2$. In inferior oils, acetic, butyric, valeric, and caproic acids, which are putrefaction products, may occur. (2) Vitamin A, vitamin D, and a varying amount of vitamin E. Average samples contain about 2,000 units of vitamin A and about 100 units of vitamin D per gramme. Only oils with a stated quantity of vitamins A and D should be used. The vitamin content is assayed biologically.

Storage.—Cod-liver oil should be kept in a well-filled, tightly closed container and protected from light.

Doses.—Horses and cattle, ʒi. to ʒiv. ; sheep and pigs, ʒi. to ʒss. ; dogs, ʒx. to ʒi.

Emulsio Olei Morrhuae (Emuls. Ol. Morrh.).—Emulsion of Cod-liver Oil; Cod-liver Oil, 50; Acacia, 12.5; Tragacanth, 0.7; Volatile Oil of Bitter Almonds, 0.1; Soluble Saccharin, 0.01; Chloroform, 0.2; Distilled Water to 100.

Dose.—Dogs, ʒxx. to ʒii.

Extractum Malti cum Oleo Morrhuae (Ext. Malt. c. Ol. Morrh.).—Extract of Malt with Cod-liver Oil. Contains 15 per cent. of cod-liver oil.

Dose.—Dog, ʒi. to ʒiv.

Oleum Hippoglossi (Ol. Hippogloss.).—Halibut-liver Oil.

Source.—Halibut-liver oil is the fixed oil extracted from the fresh or preserved liver of the halibut, *Hippoglossus vulgaris*.

Characters.—A pale yellow oil, fishy smell and fishy taste.

Halibut-liver oil contains in each gramme not less than 30,000 units of vitamin A, and about 2,000 units of vitamin D.

Doses.—Dogs, ʒi. to ʒv.

ACTIONS AND USES.—The principal value of cod-liver oil and of halibut-liver oil lies in their content of vitamins A and D, and they are used to supply these substances. In the doses employed the oils can afford only a very small amount of nutriment.

In canine practice these oils are preferably employed in the form of emulsion. Many convenient combinations with malt and the hypophosphites are now prepared. These are less liable to be rejected than the oils themselves, which occasionally induce nausea and diarrhoea.

Crude forms of cod-liver oil are prepared for administration to cattle, but usually contain much impurity.

Calciferol.

Calciferol (Calciferol).—Calciferol.

Source.—Prepared by the ultra-violet irradiation of ergosterol in a suitable solvent, and subsequent purification.

Characters.—Colourless crystals, odourless.

Assay.—Standardized to contain 40,000 units of antirachitic activity in 1 milligramme.

Doses.—Dogs, 1,000 to 3,000 units.

Liquor Calciferolis (Liq. Calciferol.).—Solution of Calciferol. Calciferol in oil, such as arachis oil, contains about 3,000 units of antirachitic activity in 15 minims.

Solution of calciferol is of value as a source of vitamin D and is used in the prevention and treatment of rickets.

Sapo Animalis (see p. 336).**Pepsin.**

Pepsinum (Pepsin.).—Pepsin. An enzyme obtained from the fresh and healthy stomach of the pig, sheep, or calf.

Characters.—A light yellowish-brown powder, or pale-yellowish translucent scales; odour faint. Dissolves, with water acidulated with hydrochloric acid, 2,500 times its weight of hard-boiled white of eggs. *Incompatible* with alkalies and tannic acid.

Doses.—Foals and calves, grs. xl. to ʒi.; dogs, grs. v. to grs. x.

Glycerinum Pepsini (not official).—Pepsin, 10; Hydrochloric Acid, 1·15; Glycerin, 60; Distilled Water to 100. Contains 1 g. pepsin in 10 ml., or 5½ gr. in 1 fl. dr.

Dose.—Dog, ℥x. to ʒss.

ACTIONS AND USES.—Pepsin converts proteins into albumoses and peptones, but has no action on fats or starch. It is of service in young herbivorous animals only while they are receiving a milk diet, but may be prescribed for dogs of all ages. It is used as a digestive adjuvant in cases of dyspepsia in which it is believed that there is an insufficient secretion of pepsin.

As pepsin digests only in acid solution, it should not be combined with alkaline carbonates or bicarbonates. Nutrient enemata and suppositories should be predigested, and this is accomplished by the addition of pepsin.

There are a number of peptonized foods prepared commercially, and in canine practice it is more satisfactory to use these than to administer pepsin.

Ox Bile.

Extractum Fellis Bovini (Ext. Fell. Bov.).—Purified Ox Bile.

Source.—Evaporate 500 ml. of fresh ox bile to a quarter its volume, shake it with twice its volume of alcohol 90 per cent.; set the mixture

aside to subside; decant the clear solution, filter the remainder, wash the filter and contents with a little more alcohol, distil off most of the alcohol from the mixed liquids, and evaporate the residue until it acquires the consistence of a firm extract.

Characters.—A yellowish-green hygroscopic substance; taste partly sweet, partly bitter. Soluble in water, and in alcohol 90 per cent. Gives a colour test for the bile acids. *Impurity.*—Mucus, giving a precipitate with alcohol in watery solution.

Composition.—Purified ox bile has the composition of fresh bile, less the mucus removed by the alcohol.

Dose.—Dog, grs. v. to grs. xv.

ACTIONS AND USES.—In conditions in which there is reason to suspect a deficiency of biliary secretion, ox bile may be given as an adjuvant to the digestion of fat. It may also be combined with anthracene purgatives such as aloin and cascara sagrada, which are inactive in the absence of bile.

Bile is the only known direct cholagogue, and is occasionally prescribed in intestinal dyspepsia in the dog. It should be given in keratin capsules (see p. 346), as it is decomposed in the stomach.

Cantharides.

Cantharis.—Cantharides (*not official*).

The dried 'Spanish fly,' *Cantharis vesicatoria*, N.O. Coleoptera. In pharmacy it occurs as a brown iridescent powder, the active principle of which is cantharidin.

Cantharidinum (Cantharidin).—Cantharidin; $C_{10}H_{12}O_4$; an anhydride of cantharidic acid.

Source.—Obtained from various species of cantharis or mylabris.

Characters.—Colourless, glistening crystals; inodorous. M.p. 210° to 212° C.; volatilizes at 100° C. *Solubility.*—Very slightly in water, petroleum spirit, or alcohol 90 per cent.; more in chloroform, acetic ether or acetone; soluble in fixed oils.

Acetum Cantharidini.—Vinegar of Cantharidin (*not official*). Cantharidin, 0.05; Glacial Acetic Acid, 10; Acetic Acid to 100.

Tinctura Cantharidini (*not official*).—Cantharidin, 0.01; Chloroform, 1; Alcohol 90 per cent. to 100.

Doses.—Horses, ℥xxx. to ℥i.; dogs, ℥ii. to ℥v.

Unguentum Cantharidini (*not official*).—Cantharidin, 0.1; Chloroform, 10; Benzoated Lard, 290. Contains 0.033 per cent. cantharidin.

This preparation is unsatisfactory as a vesicant in equine practice. A more suitable ointment is that composed of 1 part of cantharides in 6 parts of benzoated lard.

Liquor Epispasticus (Liq. Epispast.).—Blistering Liquid. Cantharidin; Castor Oil; Resin; Acetone.

ACTIONS—Externally.—Applied to the skin, cantharides is an irritant, causing smarting, pain, and the formation of vesicles, which tend to coalesce. The vesication produced is less painful than that caused by strong applications of mustard, as the

irritant does not penetrate so deeply. Vesication is produced after a period varying from three to twelve hours. The vesicles, which are of large size, rupture and discharge a yellow serous fluid, which dries and forms a scale.

If the blistering ointment be too strong or if it be applied too vigorously, inflammation of the deeper layers of the dermis may occur, with suppuration, and in some cases sloughing; the hair follicles are destroyed, and a permanent blemish results. If applied to a large surface of skin, absorption of cantharidin may result, and produce the constitutional symptoms to be presently described.

Internally.—Cantharides is an irritant to the alimentary and urinary tracts, toxic doses producing gastro-enteritis, nephritis, strangury, and hæmaturia. If administered in solution, it is severely irritant to the mucous membrane of the mouth and throat, and the swollen and painful condition of the pharynx may interfere with deglutition. The gastric irritation is evidenced by vomiting in the dog. Purging, abdominal pain, shock, and collapse, are other symptoms observed. Cantharidin is absorbed from the alimentary canal, and to a less extent from the skin. It exerts an especial irritant effect on the organs by which it is eliminated from the body—the kidneys and the genito-urinary tract. Acute nephritis occurs, the urine is scanty, contains blood, and is highly charged with albumin; there is also vesical irritation, frequent attempts at micturition, and evidence of aphrodisiac effects, in the occurrence of frequent and violent priapism. The pulse becomes rapid and feeble, and the respirations laboured.

ANTIDOTES.—When cantharidin has been absorbed from the skin, the blistered part should be bathed with a warm mildly alkaline wash, and an emulsion of carbonate of potash, olive-oil, and water applied.

Oil alone should not be used, as it renders the cantharidin more soluble, and thus facilitates its absorption.

Mucilaginous drinks and demulcents should be freely given, and, if pain be evinced, anodynes combined with sodium bicarbonate are indicated.

Oil or fatty matters must not be administered as antidotes to cantharides when poisoning has occurred by ingestion, for, as has been stated, they facilitate the absorption of the cantharidin.

USES.—*Externally*, cantharides is chiefly used in veterinary practice as a vesicant, and when properly applied is a safe and effectual counter-irritant. When active counter-irritation is desirable, equal parts of a cantharides ointment (1 to 6) and the biniodide of mercury ointment (p. 145) are combined.

Weak preparations of cantharides promote the growth of hair.

A cantharides ointment is not a safe counter-irritant for the dog, as it is liable to produce severe irritation, and to become absorbed from the skin; there is also the danger of the animal's licking the blistered part. The LIQUOR EPISPASTICUS may, however, be employed, but due care must be exercised in its application.

In the application of cantharides to the skin of the horse, the following conditions should be observed:

1. Cantharides should not be employed as a counter-irritant in renal affections, in irritable conditions of the urinary tract, or in cases of debility.

2. A blister should not be applied to an acutely inflamed or irritable condition. The inflammation should be reduced by appropriate means before active counter-irritation is adopted.

3. After the application of the blister, the horse's head should be secured, so that he cannot lick or bite the blistered part. The irritation usually passes off in from twelve to twenty hours.

4. Not more than two legs of a horse should be blistered at the same time, and three weeks should elapse before the others are treated. If, after a period of thirty hours, vesication has not been satisfactorily produced, a small quantity of the counter-irritant may be again applied; in such cases, however, care is necessary in order to avoid an excessive vesicant effect.

A blister should not be immediately applied to parts which have been 'fired.'

5. In applying blisters to the limbs, it is necessary to avoid the flexures of joints, such as the posterior aspect of the knee, the anterior aspect of the hock, and the hollow of the heel, as there may result fissures of the skin which prove very refractory to treatment. The flexure should first be smeared with a little soft paraffin to protect the part against the spread of the blistering agent.

6. After vesication has subsided the part should be treated with mild antiseptic sedative applications.

7. In hot weather severe and extensive blistering should be avoided.

In some animals of nervous temperament the application of a blister may induce constitutional disturbance and a mild degree of irritative fever. In such cases the blister should be washed off and cooling astringent lotions applied.

8. If the blistered part be within reach of the tail, this should be secured, in order that portions of the blister be not carried to the surrounding parts.

Internally.—The tincture of cantharides is still occasionally prescribed as a diuretic, but, because of its highly irritant action, it is very undesirable for this purpose.

Endocrine Products.

Adrenalina (Adrenal).—Adrenaline; Epinephrine. Adrenaline is an active principle of the suprarenal medulla of mammals.

Characters.—A colourless or pale yellow crystalline powder. *Solubility.*—Sparingly in water; insoluble in alcohol (90 per cent.) and ether; readily soluble in aqueous solutions of mineral acids, and of sodium and potassium hydroxide, but not in solutions of alkali carbonates. It is not stable in neutral or alkaline solution. It should be kept dry in amber-coloured glass bottles.

Liquor Adrenalinæ Hydrochloridi (Liq. Adrenal. Hydrochlor.).—Solution of Adrenaline Hydrochloride. Adrenaline, 1; Chlorbutol, 5; Sodium Chloride; Dilute Hydrochloric Acid; in Distilled Water sufficient to produce 1,000 ml.

Doses.—Horses and cattle hypodermically, ʒi. to ʒiv.; dogs, ℥iii. to ℥x.

ACTIONS.—The myo-neural junctions of the sympathetic system are normally activated by adrenaline secretion, so that the effects produced by the introduction of adrenaline into the tissues are those of sympathetic stimulation (see p. 60). Thus, the intravenous or intramuscular injection of adrenaline is followed by constriction of all arterioles (except the cerebral and coronary vessels, which are dilated), resulting in a general rise of blood-pressure; the cardiac action is accelerated, but this is soon controlled by the inhibitory action of the vagus which results from the rise in blood-pressure; the bronchial muscle is relaxed; there is inhibition of gastric and intestinal peristalsis, and relaxation of the fundus of the bladder; the pyloric, ileo-cæcal and anal sphincters are constricted. Uterine contraction is excited in some animals, but not in others. Hepatic glycogenolysis is stimulated, and hyperglycæmia and glycosuria induced. The viscid secretion of the submaxillary and sublingual salivary glands is increased in amount. In the horse, the pupil is only very slightly dilated, but profuse sweating is elicited.

These effects, while strikingly evinced when adrenaline is injected intravenously or intramuscularly, are evanescent in character, because the drug is very rapidly oxidized in the tissues. They are very much less pronounced when adrenaline is injected subcutaneously, as, because of the local vaso-constriction which is induced, the drug is very slowly absorbed. When given by mouth adrenaline is inactive, probably because it is highly unstable in an alkaline medium, and is therefore quickly decomposed in the duodenum.

USES.—Adrenaline is principally used as a local hæmostatic, and is commonly combined with local anæsthetics. Because of the intense local capillary constriction, the part is rendered anæmic; the absorption of the anæsthetic is hindered, and its action is localized and concentrated. In addition (and this is its more important application), by rendering the area anæmic, adrenaline facilitates surgical procedure. The local anæmia is maintained for about an hour. Occasionally, when injected with local anæsthetics, considerable sloughing of tissue results. This can be largely obviated by freely diluting the adrenaline (1 in 50,000).

A subcutaneous injection of $\frac{1}{2}$ to 1 c.c. of a 1 in 10,000 solution relaxes the bronchial muscle, and such injections are employed in asthma in the dog; but for this purpose inhalations of amyl nitrite are more effective in canine practice.

While adrenaline is the most powerful hæmostatic known, its action is almost entirely local, except when given by intravenous or intramuscular injection, when, as has been indicated, it induces general constriction of capillaries. But this in itself largely precludes its being employed for its remote hæmostatic action, since such general capillary constriction elicits a rise in the general blood-pressure, and so increases the hæmorrhage.

In cardiac collapse under general anæsthesia, intravenous or intracardiac injections of 3 to 10 minims of a 1 in 2,000 solution may be given to the dog, and 1 to 2 drachms may be injected intravenously in the horse.

In laminitis the subcutaneous injection of 2 c.c. of a 1 in 2,000 solution is made on either side of the fetlock, and, if necessary, is repeated twenty-four hours later. In a number of cases, considerable relief from the acute pain is thus afforded.

The *Liquor Adrenalinæ Hydrochloridi*, injected hypodermically in 1 drachm doses two or three times daily, has been employed with apparent benefit in equine purpura.

The employment of adrenaline in the bovine and equine forms of hæmoglobinuria and in milk fever has no pharmacological justification, and such beneficial effects as have been ascribed to its use in the treatment of these conditions are unsupported by evidence.

Ephedrinæ Hydrochloridum (*Ephed. Hydrochlor.*).—Ephedrine Hydrochloride. The Hydrochloride of Ephedrine, an alkaloid obtained from *Ephedra sinica* and other species of *Ephedra*.

Characters.—Colourless, prismatic crystals. Soluble in water and alcohol (90 per cent.). Very stable. Can be boiled.

Dose.—Dog, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$.

ACTIONS AND USES.—Although of vegetable origin, ephedrine is closely related chemically and pharmacologically to adrenaline. Applied to mucous membranes, it causes blanching by capillary constriction. Its action is of much longer duration than that of adrenaline, and, unlike adrenaline, it produces remote effects when given by mouth.

It may be substituted for adrenaline in the treatment of asthma and urticaria in the dog.

Extractum Pituitarii Liquidum (Ext. Pituit. Liq.).—Pituitary (Posterior Lobe) Extract; Liquor Pituitarii; Pituitrin. An aqueous extract of the posterior lobe of the pituitary glands of oxen and other mammals. Standardized by biological assay. It contains 10 units per millilitre.

Characters.—Clear, colourless liquid; faint odour.

Pituitary extract should be preserved in sealed glass ampoules, and should not be used later than eighteen months after the date of manufacture.

DOSES.—Cow, \mathfrak{z} i.ss. to \mathfrak{z} iii.; sow, \mathfrak{M} x. to \mathfrak{M} xv.; bitch, \mathfrak{M} ii. to \mathfrak{M} xii.

ACTIONS.—The posterior lobe of the pituitary contains at least three active principles—Oxytocin, Vaso-pressin and Melanophore Dilator Substance—of which the two former are of therapeutic interest.

(a) Oxytocin, by acting directly upon the uterine muscle, causes its contraction, whether or not the animal be pregnant.

(b) Vaso-pressin directly stimulates all plain muscle, and so effects its contraction. It produces a marked rise in blood-pressure by constricting arterioles and capillaries (those of the kidney are, however, relatively only slightly affected).

The rise in blood-pressure is particularly evident in cases in which the pressure has been reduced as the result of hæmorrhage or other cause. It constricts bronchial muscle; it markedly increases intestinal peristalsis, and also contracts the bladder. By direct action on the heart muscle it slows, but augments, cardiac contraction. The flow of milk may be increased by the contraction of the muscle of the mamma.

Pituitary extract also influences carbohydrate metabolism, in that it reduces sugar tolerance and may thus occasion hyperglycæmia and glycosuria.

USES.—Because of its action on the bloodvessels, pituitrin is a powerful circulatory stimulant. Injected subcutaneously or intramuscularly, its effect is produced within one to two minutes, but, although the action of the drug is more prolonged than that of adrenaline, it soon passes off. It has proved valuable in surgical shock and as a restorative in cardiac collapse.

It is extensively employed in obstetrical work, particularly in overcoming uterine inertia. The doses are indicated above, but, if desirable, the injection may be repeated in half these doses after an interval of thirty minutes. Pituitrin must not be employed when a mechanical impediment to delivery is present.

Pituitrin is also of value in post-partum hæmorrhage, a condition which is, however, rarely encountered in the domestic animals. It is also employed in impaction colic in the horse.

Thyroideum (Thyroid).—Thyroideum Siccum; Dry Thyroid; Thyroid Extract. Prepared from the thyroid gland of oxen, sheep, and pigs. Contains 0.1 per cent. of iodine in combination as thyroxine.

Characters.—A cream-coloured, amorphous powder; with faint and meat-like odour and taste. The active principle is *thyroxine*. Thyroid should be kept in well-closed containers in a cool place.

Dose.—Dogs, gr. $\frac{1}{4}$ to grs. v.

Thyroxinum (not official).—Thyroxine. White crystalline powder, insoluble in water. Contains 65 per cent. of iodine.

Dose.—Dogs, gr. $\frac{1}{100}$ to gr. $\frac{1}{10}$.

Thyroxinsodium (Thyroxinsod).—Thyroxine-Sodium. Prepared by the action of sodium carbonate upon thyroxine. Contains not less than 61 per cent. and not more than 65 per cent. of iodine.

Characters.—A white crystalline powder. Sparingly soluble in cold water; more soluble in solutions of sodium carbonate, and sodium hydroxide, but unstable in alkaline solutions. Thyroxine-sodium should be kept in well-closed containers.

Dose.—Dogs, gr. $\frac{1}{80}$ to gr. $\frac{1}{10}$.

ACTIONS.—Dry thyroid extract, when given by the mouth, produces its specific effects, but these are more certain when thyroxine or thyroxinsodium is administered intravenously or subcutaneously. The action is delayed, and when a single large dose of thyroxine is administered, six to eight days elapse before its maximal effect is produced, but the effect may continue, although in decreasing degree, for four to five weeks. A series of small doses elicits a more powerful effect than a single large dose. Thyroxine greatly increases the basal metabolic rate, principally because of its increasing the oxidation of fats and carbohydrates, and when the drug is given in repeated doses a marked reduction in body-weight results.

Uses.—Thyroid and thyroxine have proved of remarkable specific value in congenital thyroid deficiency (cretinism) and hypothyroidism (myxœdema) in man (Substitution Therapy). The treatment of these conditions is not called for in veterinary practice.

Although thyroid is indicated in the early stages of paren-

chymatous goitre, this condition, which is of rare occurrence in animals, is more usually treated by iodide administration.

In a number of cases in dogs of chronic skin affections, including eczema and psoriasis, of ill-defined nature, dry thyroid proves of marked benefit. The subjects are usually obese animals, and it is possible that such conditions are associated with a minor degree of hypothyroidism. The drug should be administered in small repeated doses, and the effects carefully observed, it being borne in mind that the effect of the medicament will continue for at least a fortnight after the administration has ceased.

Parathyroideum.—Parathyroid (*not official*). Prepared from the desiccated parathyroid gland of oxen.

Characters.—A pale yellowish powder; only a slight odour.

Dose.—Dogs, 2 to 15 units.

ACTIONS AND USES.—The parathyroid secretion is intimately concerned in calcium metabolism, and parathyroidectomy is quickly followed by an excessive excretion of calcium, tetanic convulsions and death.

An intravenous injection of parathyroid extract can quickly effect the disappearance of the symptoms of milk fever in cows, but this is likely to be quickly followed by a recurrence of the attack. It has been suggested that in the treatment of milk fever its administration may be combined with the injection of calcium salts; but the rapid and complete cure of the disease can now be obtained by calcium therapy alone (p. 464).

Several preparations of parathyroid gland—*e.g.*, parathormone, paroidin—standardized by biological assay, are prepared commercially.

Insulinum (Insulin).—Insulin. Insulin contains the specific anti-diabetic principle of the mammalian pancreas. Standardized by biological assay. Its potency is expressed in units per millilitre.

Characters.—A clear, colourless liquid. Insulin should be stored in sealed glass ampoules, and should not be used later than eighteen months after the date of manufacture.

Doses.—Horse and cow, 100 to 250 units; dog, 5 to 50 units.

The dose is based upon the glucose concentration in the blood and upon the carbohydrate intake.

ACTIONS.—The mode of action of insulin is unknown, but when administered to an animal the subject of hyperglycæmia and consequent glycosuria, it causes a fall in the amount of sugar circulating in the blood and the disappearance of sugar from the urine. Insulin would therefore appear to render the sugar capable of being absorbed by, and metabolized in, the tissues.

USES.—Insulin is inactive when given by mouth, as it is destroyed by the digestive juices; it is therefore administered subcutaneously as an aqueous solution. Insulin is of particular service in diabetes mellitus, in that it relieves the symptoms, but, so far as is yet known, it does not possess curative effect. It has not been generally adopted in diabetes mellitus in dogs, as the treatment of this condition is rarely desirable.

In post-parturient acetonæmia in milch cows (p. 398), insulin may be given in conjunction with large quantities of readily assimilable carbohydrates with the object of overcoming the ketosis. For this purpose, massive doses (200 grammes) of glucose in 20 per cent. solution, with 100 to 150 units of insulin, are advised. For the simultaneous administration of glucose and insulin approximately 2 grammes of glucose should be given with each unit of insulin.

Insulin has been used empirically in the treatment of azoturia in horses (equine myoglobinuria), the dosage suggested being 100 to 200 units repeated three or four times daily for at least two or three days. While the pharmacological basis for this treatment is not understood, it appears to be followed by some degree of success.

Extractum Hepatis Liquidum (Ext. Hepat. Liq.).—Liquid Extract of Liver. A selected fraction of an alcoholic extract of ox or sheep liver, dissolved in glycerin, alcohol, and distilled water. It contains the specific hæmatinic principle. One ounce contains the equivalent of 8 ounces of fresh liver.

Dose.—Dog, $\mathfrak{z}\text{ij}$. to $\mathfrak{z}\text{vi}$.

Extractum Hepatis Siccum (Ext. Hepat. Sicc.).—Dry Extract of Liver. A selected fraction of an alcoholic extract of ox or sheep liver. Contains the specific hæmatinic principle.

Characters.—A light brown, hygroscopic powder. Taste, saltish and meat-like. Soluble in water.

Dose.—Dog, a quantity equivalent to $\mathfrak{z}\text{ij}$. to $\mathfrak{z}\text{vi}$. of fresh liver.

It is now recognized that pernicious anæmia of man is alleviated to a remarkable degree by the administration of liver substance. This condition is not recognized in veterinary practice, but the administration of hepatic extracts, or the feeding of raw or lightly cooked ox or sheep liver, may prove of marked benefit in certain cases of an ill-defined group of anæmias in dogs. It is also of great service in facilitating the regeneration of blood after severe hæmorrhage. This treatment can be supplemented by feeding raw but cleanly washed portions of sheep's abomasum or, preferably, pig's stomach.

GROUP X.—VITAMINS.

The vitamins comprise a group of organic compounds occurring in various foodstuffs. They are essential to the maintenance of good health, and, when given to animals suffering from vitamin lack, possess distinct curative properties. Vitamins are readily oxidized, and tend to be destroyed when food is cooked or preserved. Under normal conditions the quantity of vitamins required is very minute.

I. FAT SOLUBLE VITAMINS.

Vitamin A.—Anti-infective. Growth promoting. Occurs in green leaves, but not in vegetable oils. Highly concentrated in animal fats, especially cod-liver oil and butter. The oil of the liver of the halibut (*Hippoglossus vulgaris*) is particularly rich in vitamin A (p. 347). The amount of vitamin A in butter fat depends upon the quantity of the vitamin or of its precursor carotene ingested by the animal. The milk of stall-fed cows, as distinct from that of grazing cows, may contain very little.

Lack of vitamin A produces arrest of growth, keratomalacia, lowered resistance to infection, especially that which may occur through mucous membrane.

Vitamin D.—Antirachitic. Is contained in cod-liver oil and in halibut liver oil. Green leaves contain only small quantities. Can be obtained from irradiated ergosterol. Lack of vitamin D produces rickets.

Vitamin E.—Anti-sterility. Occurs in cereal embryos and green leaves, and is highly concentrated in wheat germ oil. The vitamin is remarkably stable to heat, light, and air, and to chemical agents generally. Lack of vitamin E produces sterility.

2. WATER SOLUBLE VITAMINS.

Vitamin B₁.—Antineuritic.

Pulvis Vitamini B₁ (Pulv. Vitamin. B₁).—Adsorbate of Vitamin B₁. Vitamin B₁ is an adsorbate of the antineuritic vitamin upon fuller's earth. Each gramme contains 100 units of antineuritic activity.

Source.—Prepared from rice polishings, yeast, wheat embryo, and other suitable materials.

Characters.—A cream-coloured powder; almost odourless and tasteless. Insoluble in water and in mineral acids.

Vitamin B₁ Hydrochloride (*not official*).

Dose.—Dogs, mgms. 1 to 3.

Lack of vitamin B₁ produces intestinal atony and polyneuritis (beri-beri in man). It appears to play an important part in

sugar and protein metabolism. It has been used with success as an adjuvant to other treatment for extreme debility and anorexia in canine patients.

Vitamin B₂.—Known as the antipellagra vitamin.

Vitamin B₂ is now known to consist of three parts:

(1) The pigment lacto-flavine which appears to be concerned with the oxidation reactions in the cells. Lactoflavine is necessary for growth and is known to prevent cataract in rats.

(2) A factor which has been shown experimentally to be necessary to prevent dermatitis in rats when fed on experimentally defective diets.

(3) The pellagra-preventing factor. This factor has been shown to be associated with, or derived from, nicotinic acid after ingestion.

Nicotinic acid is regarded by some as the precursor of the pellagra-preventing factor. Nicotinic acid is available in the form of tablets containing 0.05 gramme, and in the form of a solution, suitable for hypodermic injection, containing 0.05 gramme in 1 c.c., these doses being suitable for canine patients.

Natural sources of vitamin B are the husks of seeds—*e.g.*, whole-grain wheat and unpolished rice. It also occurs in yeast, in eggs and in smaller quantities in green vegetables, milk, and meat.

Lack of vitamin B₂ produces pellagra in man, and in dogs a condition indistinguishable from 'Stüttgart' disease. Considerable success has followed the treatment of this condition in dogs with nicotinic acid. It must be borne in mind that the differential diagnosis of Stüttgart disease presents considerable difficulty, and this may explain the apparently conflicting results obtained with nicotinic acid in the treatment of this condition.

Vitamin B₂ has also been said to be associated with the condition known as necrotic enteritis in young pigs, but complete experimental proof is not yet available.

A lack of vitamin B₂ may be a factor concerned in certain of the indeterminate conditions of dermatitis encountered in canine patients.

Vitamin C.—Antiscorbutic.

Acidum Ascorbicum (Acid. Ascorbic.).—Ascorbic Acid.

Source.—Either from the ripe fruit of *Capsicum annum* and other vegetable sources or by synthesis.

Characters.—Minute lemon-coloured crystals; odourless; taste acid, resembling that of lemon juice. Crystalline ascorbic acid is stable when kept in a glass bottle. Solutions, especially if alkaline, deteriorate rapidly in contact with air.

Vitamin C occurs in all growing vegetables, especially green vegetables and citrus fruits, but also in tomatoes, turnips, and potatoes; the amount in potatoes is, however, very small.

Vitamin C is very readily destroyed by heat, especially if in an alkaline medium. It is also destroyed by oxidation unless in an acid medium—e.g., lemon juice and lime juice. Vitamin C is absent from preserved foods.

Lack of vitamin C produces scurvy in man, and symptoms resembling those of scurvy have been produced in small experimental animals by feeding on a diet deficient in vitamin C. Vitamin C, like vitamin B, is not stored in the body for any length of time.

Little is known of the vitamin C needs of the domestic animals. It may be that the vitamin is required by equines, but there is no evidence indicating the needs of ruminants. Experimentally it has not been found possible to produce a scurvy like disease in dogs, even after prolonged feeding of a diet containing no vitamin C. The vitamin C requirements of the pig are not known.

GROUP XI.—THE SULPHANILAMIDES AND ALLIED COMPOUNDS.

This group of drugs has attracted great attention and has been the subject of intensive research during the past few years. Considerable progress has been made in determining the pharmacological basis of the action of these drugs, and by planned experiment and clinical trial their therapeutic value is being assessed.

It must be borne in mind that results obtained in human patients cannot always be directly applied to Veterinary Medicine.

The first of these products to attract attention was prontosil (4'-sulphonamido-2,4-diaminoazobenzene). This product has been replaced by substances which are more effective and less toxic.

Sulphanilamide (*p*-aminobenzenesulphonamide), known commercially as sulphanilamide, sulphonamide or streptocide.

Benzyl Sulphanilamide (*p*-benzylaminobenzenesulphonamide), known commercially as proseptasine or 'M. and B. 125.'

Soluseptasine (disodium - *p*-(phenyl - propyl - amino-)benzenesulphonamide-*a*-disulphonate). A soluble product suitable for intravenous, intramuscular, or subcutaneous injection.

These substances are frequently referred to under the term sulphanilamide in distinction from other compounds, to which reference will be made later.

Sulphanilamide has been shown to be particularly effective against streptococcal infections, but its action varies with different groups of organisms.

Sulphanilamide is rapidly absorbed from the alimentary canal, absorption being complete in four hours. It is now known that sulphanilamide is not any more rapidly absorbed if given subcutaneously. Studies of absorption curves show that a maximum concentration in the blood is reached in about three hours, and if one dose only is given, the concentration curve falls in a straight line almost to zero in the course of twenty-four hours. It appears that before results can be obtained in the treatment of disease a concentration in the blood of 1 in 10,000 (10 mg. per 100 c.c. of blood) is necessary, therefore the therapeutic action of any single dose, provided that it is sufficient to produce the desired concentration in the blood, can persist for only about six hours. It is therefore necessary, if the action of the drug is to be maintained, that administration should be repeated in from four to six hours. It is improbable that one single dose can overcome an acute infection.

After administration sulphanilamide is uniformly distributed throughout most tissues in the body. The concentration in the cerebro-spinal fluid, however, is only about 75 per cent. of that in the blood. Sulphanilamide is excreted in the urine, and it is believed that 70 to 80 per cent. of the drug in the glomerular filtrate is reabsorbed; therefore the administration of large quantities of fluid will have the effect of washing the drug out of the body. Impairment of renal function may lead to its retention in the tissues.

It is believed that in streptococcal infections sulphanilamide acts directly on the organisms by means of some interference with their metabolism. Sulphanilamide does not neutralize bacterial toxins, and stimulates neither leucocytic activity nor antibody formation. It has recently been suggested that sulphanilamide acts by neutralizing *p*-amino-benzoic acid, which appears to be essential for the growth of streptococci and some other bacteria; *p*-amino-benzoic acid has been shown to prevent the action of sulphanilamide on bacteria.

Sulphapyridine (2-sulphanilyl-aminopyridine), known commercially as M. and B. 693 or Dagenan. This product first attracted attention because of its remarkable success in certain forms of pneumonia in human patients. It appears to be much more active than sulphanilamide, and it is suggested that a

concentration of 1 in 30,000 (3 mg. per 100 c.c.) is adequate in the treatment of certain infections. It is more slowly absorbed than sulphanilamide, but the concentration in the blood is better maintained as excretion is slower.

While this drug has been found to be particularly effective against pneumonia, it is of value in other coccal infections. Neither sulphanilamide nor sulphapyridine has been found effective against staphylococci.

Sulphathiazole, 2 (*p*-aminobenzenesulphonamidothiazole), M. and B. 760, and *Sulphamethyiazole*, methylated derivative of sulphathiazole. These products, which are more recent introductions, are more rapidly absorbed and excreted than sulphapyridine, and appear to possess only about 65 per cent. of the toxicity of that drug. They are, however, effective against staphylococci.

TOXIC EFFECTS.—It is suggested that sulphanilamide interferes with the reabsorption of bicarbonate and bases, and thus a certain degree of acidosis apparently always results. To correct this it is suggested that sodium bicarbonate should be administered concurrently with the drug.

Nausea in all animals, and nausea and vomiting in the dog, are not uncommon following full dosage. A febrile reaction may be encountered; also diarrhoea. Inco-ordination of gait, difficulty in rising, and apparent nervous excitement have been observed. Toxic symptoms usually disappear quickly when the administration of the drug is stopped and when copious quantities of fluids are given for the purpose of expediting its elimination from the body.

It is possible that sulphapyridine and sulphathiazole may cause renal damage. In the case of sulphapyridine this appears to be due to the precipitation of acetylsulphapyridine in the renal tubules, and it is suggested that the administration of bicarbonate of soda may inhibit the precipitation of the acetylsulphapyridine. The precipitation of this compound may give rise to hæmaturia, decreased renal function, and even anuria.

CLINICAL APPLICATIONS.—Beneficial effects have been obtained by the use of sulphanilamide and sulphapyridine in the treatment of pneumonia in all the domestic animals.

It is claimed that sulphapyridine is of value in controlling piglet influenza. There is some evidence that the course of strangles in the horse is curtailed by the administration of sulphanilamide. A proportion of cases of joint-ill in foals and lambs has responded to drugs of the sulphanilamide group.

Streptococcal bovine mastitis can to some extent be controlled by sulphanilamide, which in the majority of cases can be expected to effect a temporary clinical recovery, while in a number of cases the udder may be rendered free from infection.

In post-parturient sepsis a proportion of cases is benefited by the administration of either of these compounds.

As a dressing for infected wounds sulphanilamide has attracted considerable attention. It is possible that in the treatment of punctured wounds and conditions such as traumatic arthritis, this substance may prove of considerable value.

DOSAGE—Sulphanilamide.—

Horses.—An initial dose of $\frac{3}{4}$ ii. to $\frac{3}{4}$ vi., followed by $\frac{3}{4}$ ss. to $\frac{3}{4}$ ii. three or four times daily.

Foals.—An initial dose of $\frac{3}{4}$ ss., followed by $\frac{3}{4}$ i. to $\frac{3}{4}$ ii. three or four times daily.

Cattle.— $\frac{3}{4}$ iii. to $\frac{3}{4}$ vi., followed by $\frac{3}{4}$ i. to $\frac{3}{4}$ ii. three or four times daily.

Calves.—As for foals.

Sheep.— $\frac{3}{4}$ ss., followed by $\frac{3}{4}$ i. to $\frac{3}{4}$ ii. three or four times daily.

Lambs.— $\frac{3}{4}$ i., followed by grs. xv. three or four times daily.

Pigs.—grs. xl. for each 20 lbs. body weight, followed by grs. xv. for each 20 pounds body weight three or four times daily.

Young pigs, grs. vii.ss. for each 20 lbs. body weight.

Dogs.—grs. iii. to grs. xxx. three or four times daily.

Cats.—grs. i.ss. to grs. iii. three or four times daily.

Sulphapyridine.—One-third to one-half the doses of sulphanilamide.

GROUP XII.—VACCINE AND SERUM THERAPY.

The term 'immunity,' as it is applied in medicine, means a condition of partial or complete resistance to pathogenic agents such as are represented by micro-organisms and their toxic products.

Immunity may be (1) *natural*—e.g., the non-susceptibility of the horse to foot and mouth disease, and of cattle to glanders—or (2) *acquired*.

Acquired immunity may be developed (a) as the result of natural infection by a specific pathogenic micro-organism, or (b) by the artificial introduction into an animal's tissues of specific micro-organisms or their products, so modified that they are no longer capable of causing disease. The infective agent possesses not only a *pathogenic* or disease-producing factor, but

also an *antigenic* factor, or 'antigen,' which can excite the production of specific 'immune bodies' or 'antibodies' capable of rendering inactive those particular infective agents which have stimulated their production.

The pathogenic factor, in contradistinction to the antigenic factor, is relatively labile, and its virulence can be attenuated in various ways—*e.g.*, by cultivating pathogenic micro-organisms at temperatures above the optimum, by desiccation, or by subjecting the micro-organisms, or their toxins, to the action of chemical agents, etc. By such means the product may be rendered relatively or absolutely avirulent, but, if the stable antigenic factor be not destroyed, it is capable of exciting the production of antibodies, and of so inducing immunity. Such a product, when used in therapeutics, is known as a vaccine, and in the preparation of vaccines their pathogenic factor is, if possible, rendered inert, while the integrity of the antigen is, in so far as that is practicable, conserved. It is not, however, always possible to destroy the virulence of the micro-organism or toxin used in the preparation of a vaccine without seriously damaging its immunizing properties, and unless the risk which attends the use of such products be slight, their application to Veterinary Therapeutics is precluded.

The process of immunization may, however, be commenced by a dose of highly attenuated or dead micro-organisms followed by a series of doses of increasing virulence, or the primary vaccine may be accompanied by the simultaneous injection of an immune serum (p. 365).

ACTIVE IMMUNITY.—Vaccines, because they *actively* excite the production of 'antibodies,' are said to effect an active immunity. Active immunity is developed after an interval, the duration of which presents considerable variation, but is usually about one to two weeks. Once the production of antibodies is started, however, these are usually continuously present in the tissues for prolonged periods, and the condition of active immunity may persist throughout the life of the animal.

Vaccines are principally employed for prophylactic purposes, but are also used in the treatment of chronic infections—*e.g.*, streptococcal mastitis. In such cases it is desirable that the vaccine be prepared from the particular micro-organism actually concerned in the infection—*i.e.*, the micro-organism is directly derived from the affected animal. Such vaccines are known as *autogenous*, as distinct from *stock vaccines*, which are prepared from one type (monovalent vaccines), or several types (polyvalent vaccines) of micro-organisms obtained from cases of disease similar to that from which the patient is suffering.

PASSIVE IMMUNITY.—When an animal has been actively immunized by the repeated injection of progressively increasing doses of a particular micro-organism or its toxic product, if the process be further continued a very high degree of immunity may be obtained. The blood serum of such an actively immunized animal is rich in specific antibodies and, if it be now injected into a susceptible animal, this animal is rendered immune to the disease. It will be observed that the immunity is not actually produced by, but gifted to, the second animal. This is known as a passive immunity.

Passive immunity is established immediately after the immune serum is injected, but is of transient duration. It is commonly effective for a period of only ten to fourteen days, and usually disappears within one to two months, its disappearance being due to the elimination of the antibodies from the animal organism.

Immune sera are employed for prophylactic purposes, in which case the serum is injected shortly before, or immediately after, exposure to infection. Immune sera are also used in curative treatment, for which purpose they should be injected in relatively large doses as soon as is possible after the appearance of the clinical symptoms.

Anthrax.

Anthrax is an acute infective disease caused by the *Bacillus anthracis*.

Prophylactic vaccination against anthrax is in this country seldom practised, although cattle are occasionally immunized previous to their being grazed on pastures in which the disease is known to occur in high incidence.

PASTEUR'S METHOD.—Two vaccines are employed and consist of cultures of non-sporulating anthrax bacilli of different degrees of attenuation.

The first vaccine is prepared from a broth culture, attenuated by growing the bacilli at 42° C. to 43° C. for fifteen to twenty days. The second vaccine is prepared from a sub-culture grown at 37° C. for ten to twelve days. It thus possesses a higher degree of virulence than the first vaccine. The first vaccine produces a considerable degree of immunity. This is enhanced by the second vaccine, which is injected after an interval of ten to fourteen days. The injections are made subcutaneously behind the shoulder.

The vaccine is difficult to standardize, and its use is attended by considerable risk. It is estimated that 0·5 per cent. of inoculated animals may contract anthrax as the result of inoculation. On

the other hand, the antigenic power of the vaccine may be so low that it fails to confer immunity to natural infection.

Immunity is established in from ten days to one month after the second inoculation, and persists for one year.

SOBERNHEIM'S SIMULTANEOUS METHOD.—In this method an active and passive immunity are conferred by the simultaneous injection of vaccine and immune serum. The immune serum is prepared by inoculating cattle or sheep with cultures of increasing virulence. The vaccine consists of a culture attenuated by growth at 42·5° C.

In practice, subcutaneous injections of 10 to 16 c.c. of immune serum and 0·5 to 1 c.c. of vaccine are made simultaneously.

The method has the advantage of being safe. It confers a passive immunity on the animal while an active immunity is being developed. It can, therefore, be employed during the course of epizootics.

SPORE VACCINE.—*Bacillus anthracis* forms spores in the presence of oxygen; these are highly resistant to chemical disinfectants.

By the treatment of the spores with chemical agents a vaccine has been prepared which has given satisfactory results in those countries where the incidence of anthrax is high.

ANTI-ANTHRAX SERUM.—This serum confers a passive immunity that is useful for the protection of valuable animals during an outbreak of anthrax in the herd, pending the completion of other active measures to control the spread of the disease, such as disinfection and the disposal of carcasses.

Black Quarter.

ARLOING'S METHOD.—The causative organism of black quarter (*Clostridium chauvoei*) occurs in pure culture in the muscles of affected animals, and in Arloing's method vaccines are prepared with infective muscle.

The infected muscle is dried, powdered and subjected to two different degrees of attenuation by dry heat (100° to 104° C. for six hours, and 85° C. to 90° C. for the same period).

The more attenuated vaccine is first injected, the injection being made on the under surface of the tail; this is followed by the injection of the second and less attenuated vaccine ten days later. Strict aseptic precautions must be observed.

Immunity to natural infection develops in about eight to ten days after the second injection and lasts for about eighteen months. The vaccination should, therefore, be practised on calves six to eight months of age, and the immunity conferred should

thus protect the inoculated animals during the period of greatest susceptibility (six months to two and a half years of age).

Although this method has been used with marked success, it is not without danger, in that the vaccines consist of living organisms, and since they cannot at present be accurately standardized, deaths directly due to the inoculation occasionally occur.

BACTERIA-FREE FILTRATES—AGGRESSINS.—In order to obviate the risks associated with the inoculation of living vaccine, bacteria-free filtrates (so-called aggressins) are now largely employed, and have proved of marked prophylactic value.

Infective muscle juice is extracted under pressure and filtered. The filtrate is then standardized and tested for potency and sterility. A single injection of 5 c.c. produces a high degree of immunity which persists for about one year.

Since such vaccines are germ-free, they can be used with complete safety.

ANACULTURE VACCINES.—These are prepared by subjecting broth cultures of *Cl. chauvoei* to the action of formalin—0·3 to 0·5 per cent. Such formalinized whole-culture vaccines are known as anaculture vaccines. Experimentally, it has been shown that anacultures confer a high degree of immunity, but their prophylactic value, as compared with that of vaccines prepared from bacteria-free extracts, has still to be determined.

Braxy.

In Scotland, *Clostridium septique* is constantly associated with braxy in sheep. Several forms of vaccine prepared from this organism have been devised, of which among the most successful is a formalinized whole culture, or anaculture. This is prepared by growing *Cl. septique* in a special broth medium containing horse flesh. After twenty-four hours' growth, 0·5 per cent. formalin is added to the culture, which is then incubated for a further period at 37° C. The product is then tested for sterility. Two inoculations of anaculture are made subcutaneously on the inner aspect of the thigh at an interval of fourteen days. The dose on each occasion is 5 c.c.

Lamb Dysentery.

Lamb dysentery is caused by a specific type of *Clostridium welchii*. Lambs are particularly susceptible to infection during the first few days of post-natal life.

Two methods of immunization are employed:

1. VACCINATION OF THE EWE.—The vaccine consists of an anaculture prepared from the lamb dysentery bacillus. Ewes are inoculated subcutaneously with 5 c.c. of vaccine in the autumn before being put to the rams. A second inoculation is made in spring about one week before lambing commences. Antitoxin appears in the blood and colostrum of the actively immunized ewe, but the blood serum of her lamb at birth contains no antitoxin. Shortly after the ingestion of the colostrum of the dam, however, the presence of specific antibodies can be demonstrated in the blood. A passive immunity is thus conferred upon the lamb, which is protected during the period of susceptibility.

2. SERUM INJECTION OF THE LAMB.—Lamb dysentery antitoxin is prepared by inoculating horses with increasing doses of toxin. The antitoxic titre of the horse's serum is tested at intervals, and when the requisite titre has been obtained, the horse is bled, and the serum separated from the clot and preserved. The lamb at birth receives a subcutaneous injection of 5 c.c. of serum.

Both methods have proved very effective in the prevention of lamb dysentery. The choice of method depends upon the conditions of management which obtain in the flock.

Pulpy Kidney Disease.

'Pulpy kidney' is a disease of lambs in forward thriving condition when they are a few weeks old. The disease manifests itself as a very acute illness, terminating in death in a few hours; death in many cases being preceded by convulsions. The term pulpy kidney disease is derived from the fact that the kidney disintegrates rapidly after death. The disease is caused by a variant of *Clostridium welchii*.

The disease may be controlled by the subcutaneous injection of the lambs at two weeks old with a pulpy kidney antiserum. On badly infected farms this may be repeated when the lambs are six weeks old.

Tetanus.

Antitetanus serum is prepared by rendering horses immune to tetanus by graded injections of a sterile filtrate (toxin) of *Clostridium tetani*.

Blood is drawn from the animal periodically and tested in guinea-pigs to ascertain its antitoxic titre against an official test dose of tetanus toxin. The antitoxic unit is that defined in the Regulations made under the Therapeutic Substances Act, 1925.

When the requisite degree of immunity has been reached, the

horse is bled and the serum is collected and preserved (see also Tetanus, p. 457).

Active immunity against tetanus may be induced by the injection of tetanus anatoxin—an alum precipitated toxoid prepared from cultures of *Clostridium tetani* by treatment with formaldehyde. Two injections at an interval of one month confer a high degree of immunity lasting for several years.

Streptococcal Infections.

Several proprietary preparations of stock polyvalent sera are prepared by immunizing horses against progressively increasing doses of killed streptococci of equine origin. They include the several pyogenic organisms.

Clinical reports indicate that these sera are frequently of value in the treatment of various septic infections, strangles, influenza, etc., but many observers are unable to report favourably upon their use.

The sera are used both for prophylactic and curative purposes.

White Scour.

White scour sera are prepared by immunizing horses against repeated injections of micro-organisms isolated from cases of white scour. These organisms include various types of *Escherichia coli*.

In the preliminary injections, dead cultures are used, and after a degree of immunity has been established, living organisms are inoculated. When a high degree of immunity has been obtained, the horses are bled.

The serum is employed for prophylactic and curative purposes, but its use in practice has been attended by irregular results.

Swine Erysipelas.

The method now employed in the prevention of swine erysipelas is that of sero-vaccination.

Immune serum is prepared by the repeated inoculation of horses with the swine erysipelas bacillus (*Erysipelothrix rhusiopathiae*).

SWINE ERYSIPELAS ANTI-SERUM is of considerable value in the treatment of the acute form of the disease. Large doses are required and these may be repeated, if thought necessary, after an interval of one, two, or three days. Serum may also be employed to control the spread of the disease on infected premises. The passive immunity conferred by the serum may be converted into an active immunity if the pigs are brought

into contact with natural infection on the premises where the disease exists. The passive immunity lasts about three weeks. If it is thought desirable the non-infected pigs may be given a dose of swine erysipelas live vaccine seven to ten days after they received serum.

SWINE ERYSIPELAS VACCINE consists of living cultures of the causal organisms which by repeated subcultivation have largely lost their pathogenic properties but still retain their antigenic powers. The vaccine is administered simultaneously with a balanced dose of swine erysipelas antiserum. Two syringes, one for serum and one for vaccine, are used and the vaccine is injected on one side of the body and the serum on the opposite side. Care must be taken that the serum and vaccine are not brought in contact with one another. This method is only suitable for healthy pigs on non-infected premises. It is useful to apply to susceptible pigs before introducing them to infected piggeries.

Swine Fever.

ANTI-SWINE FEVER SERUM.—This consists of serum or defibrinated blood obtained from hyperimmunized pigs.

A pig which has passed through an attack of swine fever, and has therefore developed an active immunity, is hyperimmunized by intravenous injections of blood from pigs suffering from an acute attack of swine fever. At least ten days after the last injection the pig is bled, and the serum so obtained is preserved. Before use the serum is tested for potency by observing the effects of injecting virulent blood into test pigs which have received different quantities of serum.

Serum injected into healthy pigs confers a passive immunity lasting only a few weeks, but the practice obtains of first rendering incontact swine passively immune by means of an injection of hyperimmune serum, and then immediately exposing them to natural infection in the hope that an active immunity will thus be developed.

In outbreaks in which swine fever appears in an acute form and in which the disease has been diagnosed early, so that the infected animals are limited in number, the method above described has met with marked success. Outbreaks of swine fever suitable for serum treatment must, however, be carefully selected, as the indiscriminate adoption of the method has brought ill-deserved discredit upon its usefulness. The serum is injected subcutaneously. In the case of small pigs, the injections are made in the inner aspect of the thigh, and in adult animals under the loose skin behind the ear. The dose varies from 10 to 30 c.c.

THE SIMULTANEOUS METHOD.—Immunity can be induced by the simultaneous inoculation of hyper-immune serum and virulent blood. The dose of serum employed is usually 20 c.c., and that of virulent blood 1 to 2 c.c. The method gives a lasting immunity, but possesses the disadvantage that the use of virulent blood involves a certain element of danger, although Dorset insists that this danger can be minimized by injecting excessive doses of the serum which, while not interfering with the production of an active immunity, effectively protect the pigs against the action of the virus.

Canine Distemper.

The cause of canine distemper is a filterable virus, and it is possible to immunize dogs against the disease (Laidlaw, Dunkin, and Dalling).

Two methods of producing an active immunity have been devised: (1) vaccine followed by virus and (2) serum and virus injected simultaneously. At present preference is given to the second method, owing to the difficulty of ensuring that the dog does not encounter natural infection during the extended period that is required for the production of immunity by the first method.

I. 'VACCINE AND VIRUS METHOD.'—The '*vaccine*' is a formalinized spleen pulp obtained from an infected dog. It contains only dead virus and is, in itself, innocuous. It is injected subcutaneously in the region of the shoulder, the dose being 5 c.c.

The '*virus*' is obtained in the spleen pulp of infected ferrets, which is dried *in vacuo* at a low temperature. The dose of virus is 1 c.c., and is injected within seven to twenty-one days after the vaccine, preferably about the fourteenth day. The injection is made in the region of the shoulder, on the opposite side of the body to that on which the vaccine was injected.

It is to be realized that the virus is highly infective, and great care must be exercised in the sterilization of the syringe and in the disposal of the containers, etc.

The injections must be made with all due aseptic precautions.

The method should not be employed in puppies of less than eight weeks of age. It would appear that the age of twelve weeks constitutes the most suitable period at which to immunize.

The method should be applied only to dogs in sound health, and should not be practised when symptoms of even slight malaise are apparent. The temperature must be recorded daily for a period of two to three days before and after the injection of the vaccine, and for several days, preferably one week, before and

after the injection of the virus. Little or no febrile disturbance should follow the injection of the vaccine, but should the temperature rise to 103° F., the injection of virus must not be proceeded with. Symptoms of malaise may appear about the fourth day following the injection of virus; in such cases the dog must be kept quiet and all exertion avoided. The dog should not have been in contact with distemper infection for at least a fortnight previous to the injection of the vaccine, and should not be exposed to distemper infection during the period of immunization, and for one week after its completion.

2. SERUM AND VIRUS METHOD.—This method consists in injecting simultaneously hyperimmune serum and virus. Two syringes, one for serum and the other for virus, are employed. The injections are made on opposite sides of the body. The conditions which must necessarily be observed in the 'vaccine-virus method' also apply to the simultaneous method. In the event of a dog exhibiting symptoms of distemper within ten days after the injection, an intramuscular injection of 10 to 20 c.c. of immune serum should be given immediately.

HYPERIMMUNE CANINE DISTEMPER SERUM.—The serum is prepared by the inoculation of a massive dose of distemper virus into an actively immune dog, and after a suitable interval the animal is bled and the serum collected.

1. The immunity conferred by serum is of short duration, and lasts only about one week, but it is probable that the serum will prove of value as a prophylactic in the case of susceptible animals exposed to distemper infection. Evidence indicates that even when given four days after exposure to infection, the development of the disease can be effectively prevented.

The dose is approximately 10 c.c., injected subcutaneously or intramuscularly.

2. When given in adequate doses in the early stages of distemper, the serum possesses distinct curative action, and in many instances it has been found to abort immediately an attack. Further clinical evidence is, however, required before its curative value can be precisely determined.

The injections are made intravenously (external saphena), or intramuscularly, and should be given daily until improvement occurs. The dose is 20 to 50 c.c., depending upon the severity of the attack.

Infectious Feline Enteritis.

Infectious feline enteritis is an acute disease of cats associated with fever and diarrhoea. The majority of cases terminate fatally. The disease has been shown to be due to a virus

from which a formalinized vaccine has been prepared. Two injections are given at an interval of seven to ten days. The immunity so produced lasts at least several weeks.

Infective Canine Jaundice.

SPIROCHÆTOSIS ICTERO-HÆMORRHAGICA ('YELLOW'S').—Infective jaundice of dogs is due to *Spirochaeta (Leptospira) ictero-hæmorrhagiæ*.

1. **VACCINE.**—A high degree of active immunity can be induced by the injection of vaccines, prepared from *Leptospira ictero-hæmorrhagiæ*, which have proved of marked prophylactic value in kennels in which the disease is enzootic. Vaccines should not, however, be used in the case of dogs under one month of age. The dose usually employed is 1 c.c., injected subcutaneously. The injection is repeated after an interval of ten days.

2. **SERUM.**—*Leptospira* serum, in doses of 5 to 10 c.c. by subcutaneous injection, affords a high degree of protection from the disease. The immunity lasts about two to three weeks. When injected during the first four days after exposure to infection, the attack is usually effectively aborted. For this purpose 10 to 20 c.c. are injected intravenously or intramuscularly; if necessary, the injection may be repeated on the following day.

Contagious Bovine Abortion.

For immunization against contagious bovine abortion two types of vaccine are employed:

1. **LIVING CULTURE VACCINES.**—These are prepared by cultivating *Brucella abortus* in a special broth medium, and after testing the purity of the culture the living organisms are inoculated subcutaneously into non-pregnant animals at least two months before the period of service. Cows may be vaccinated as soon as they have completely recovered from calving and the vaginal discharge has ceased. The dose employed is 50 c.c., and the injection is usually made at about the middle of the lower part of the neck.

There is a general consensus of opinion that living vaccines confer some degree of protection. It is to be realized, however, that their use is restricted to carefully selected herds. They should not be employed in herds other than those in which gross infection exists, since the use of living vaccines may perpetuate the infection.

2. **DEAD VACCINES.**—These usually consist of broth cultures killed by heat, or of surface growths on agar washed off in saline solution, standardized to a certain degree of opacity and then

killed by heat. There is as yet no definite evidence of the value of dead vaccines in the prevention of contagious abortion, and it is generally considered that such vaccines possess little if any prophylactic value.

3. **VACCINES OF REDUCED VIRULENCE.**—Considerable attention has been paid in recent years by research workers to the possibility of producing a living but attenuated vaccine that will afford an adequate degree of immunity. Certain progress in this direction has been made, but it is not yet possible accurately to assess the value of such vaccines.

THE APPLICATION OF BIOLOGICAL TESTS IN CLINICAL DIAGNOSIS

TUBERCULIN.

Tuberculin is employed for the diagnosis of tuberculosis. It is prepared by cultivating the tubercle bacillus—*Mycobacterium tuberculosis (bovis)*—in glycerin bouillon. The culture is sterilized by steam at 100° C., and the dead organisms are removed by filtration. The filtrate is then concentrated to one-tenth of its volume, and this constitutes Koch's 'old tuberculin' (French: *tuberculine brute*). 'Old Tuberculin' of bovine origin is official (B.P. 1932) under the designation TUBERCULINUM PRISTINUM P.T. Its standardization is controlled by the 1931 Regulations of the Therapeutic Substances Act (1925). Preparations of 'Old Tuberculin' other than TUBERCULINUM PRISTINUM may be employed in veterinary practice.

Concentrated or old tuberculin is used for the OPHTHALMIC TEST and the DOUBLE INTRADERMAL TEST as recommended by the Tuberculin Committee of the Medical Research Council.

Tuberculin prepared from cultures of the tubercle bacillus grown on synthetic medium is now employed officially for the DOUBLE INTRADERMAL TEST.

For the SUBCUTANEOUS TEST, old tuberculin is diluted with 9 parts of 0.5 per cent. phenol. Diluted tuberculin is also used for the INTRADERMO-PALPEBRAL TEST (Moussu), and for the INTRADERMAL TEST, but in this test the concentrated tuberculin is commonly employed.

SUBCUTANEOUS TEST.

CATTLE.

The animals to be tested must be housed, and for four or five days before the test is applied they must be subjected to the conditions which are to obtain during the test period. The temperatures of the animals should be taken morning and evening on the day preceding the tuberculin injection. The test should not be applied if the subject be suffering from a febrile condition or affected with any acute disease. The temperature of the building must be kept as even as possible; the diet should not be changed, and large draughts of cold water must not be allowed for some time previous to and during the test period.

The injection is made with a sterile hypodermic syringe furnished with a sharp needle $\frac{1}{2}$ to 1 inch long No. 20 (standard wire gauge) in diameter. The tuberculin is injected into the subcutaneous tissue under the loose skin in front of, or behind, the shoulder. The dose of tuberculin varies with its method of preparation; of British tuberculin, cows are given 3 c.c., and bulls 4 c.c.

The temperature is taken at the time of injection, and again at the ninth, twelfth, fifteenth, and eighteenth hours.

In a positive reaction the temperature rises *gradually* to at least 104° F., and the rise in temperature is accompanied by general febrile disturbance. The temperature gradually returns to normal within twenty-four hours. The intensity of the reaction is no criterion of the extent of the disease.

A temperature registering between 103° and 104° F. must be regarded as suspicious, and the animal should be re-tested after an interval of at least one month. Cases in which the temperature does not reach 103° F. may be regarded as non-tuberculous. If the temperature at the eighteenth hour be in the region of 103° F., it should be taken also at the twenty-first hour, as in some animals the positive reaction may not be produced until this period has elapsed.

The temperature curve in a typical reaction is gradual. Animals exhibiting sudden unsustained rises of temperature cannot be regarded as positively tuberculous, and in these the test should be repeated. The test is unreliable in the case of animals in an advanced stage of tuberculosis, but Begg and others have found that in such animals positive reactions may occur within the first twelve hours, the maximum temperature occurring about the ninth or tenth hour.

The subcutaneous test fails to elicit a reaction for some time after infection; this is a very variable period, and is stated to range from eight to fifty-one days.

A reaction to the subcutaneous test may prevent a subsequent reaction if the test be shortly repeated. As has been indicated, in the case of doubtful reactions an interval of at least one month should be allowed to elapse before the test is again applied; but Vallée has shown that, thirty-six to forty-eight hours after a previous injection, cattle will again react if double doses be administered. In this case, however, the thermal reaction develops earlier (fourth to ninth hour), and is of shorter duration, so that the temperatures should be taken at the second hour after the injection of the tuberculin, and at two-hourly intervals until the fourteenth or sixteenth hour.

HORSE.

The test is applied in the same manner and under conditions similar to those observed in the case of cattle.

The temperature at the time of injection should not exceed 101.5° F. The dose of British tuberculin varies with the size of animal—from 5 to 8 c.c.

In a positive reaction the temperature rises through at least 1.5° F. (according to some authorities, a rise of 1° F. should be regarded as a positive reaction), and there is sometimes exhibited at the site of injection a firm swelling, which disappears in from eighteen to twenty-four hours.

DOG.

The subcutaneous test is employed in the diagnosis of tuberculosis in the dog, but it must be regarded as unreliable.

According to Gray, the dose varies from 0.5 to 1 c.c., depending upon the size of the animal, or it may be calculated at $\frac{1}{8}$ to $\frac{1}{2}$ minim per pound body-weight.

The temperature is taken twice before the injection of the tuberculin, which is made into the subcutaneous tissue in the region of the flank or on the inner aspect of the thigh.

The temperature is then taken every hour after injection until at least the tenth hour (the thermal reaction may occur within two hours after injection—usually about the fifth or seventh hour). The thermal reaction is accompanied by considerable general disturbance, and passes off within twenty-four hours.

In advanced and generalized tuberculosis, and in febrile conditions, the reaction is feeble, and may pass unperceived.

CAT.

According to Gray, the dose of tuberculin is from 1 to 5 minims, and after injection the temperature should be taken every hour, as the maximum is reached about the fifth hour and soon declines to normal.

The test is unreliable in this animal.

OPHTHALMIC TEST.

CATTLE.

The animal's head is held by an assistant, and is turned in a lateral direction. A few drops of 'old tuberculin,' containing no phenol (see p. 375), are instilled into the conjunctival sac by means of an eye-dropper or graduated syringe. The upper eyelid

is lightly massaged with the tip of the finger, in order to disperse the tuberculin throughout the sac. The other eye is left as a control.

A positive reaction is elicited between the sixth and twelfth hour after instillation, and consists in congestion of the conjunctiva, lachrymation, oedema of the eyelid and of the nictitating membrane. Later (between the twelfth and twenty-fourth hour), these symptoms are accompanied by a muco-purulent discharge. The result of the test is conveniently read at the twenty-fourth hour.

The period of reaction varies from one to three or four days. A catarrhal conjunctivitis, accompanied only by lachrymation, does not constitute a positive reaction.

The severity of the reaction is no criterion of the extent of the disease.

Unlike the subcutaneous test, the ophthalmic test may be repeated, and a positive reaction again obtained within a few days of the first test. If a positive or doubtful reaction be shortly followed by the subcutaneous test, the ophthalmic reaction may recur as the result of the conjunctiva having become sensitized, while the subcutaneous reaction is not interfered with.

The ophthalmic is not so reliable as the subcutaneous test, and although a positive reaction may be accepted as indicating tuberculosis, negative reactions cannot be relied upon as indicating the absence of the disease.

The ophthalmic and the subcutaneous tests were commonly employed simultaneously.

INTRADERMO-PALPEBRAL TEST.

CATTLE.

This test, which was introduced by Moussu, consists in the injection of 2 minims of diluted tuberculin (p. 375) into the skin of the lower eyelid. The technique is similar to that employed in the intradermo-palpebral test for glanders in the horse (p. 381).

A positive reaction consists in the development (about twelve hours after injection) of a voluminous and persistent palpebral oedema, accompanied by a muco-purulent discharge from the inner canthus.

The maximum reaction is obtained at about the forty-eighth hour, after which there is a gradual decline, but four or five days may elapse before the reaction disappears. In doubtful reactions the test can be repeated immediately on the other eye, or the subcutaneous test can be applied as its reaction is not affected by a previous intradermo-palpebral test.

The intradermo-palpebral test may be repeated at short intervals, as a reaction does not interfere with subsequent tests.

According to Moussu, the test possesses the following advantages over the subcutaneous test:

1. Test animals do not require to be confined prior to the application of the test.
2. The test may be applied to animals in a febrile condition.
3. The test may be applied to all animals in a byre or at pasture, and at any time of the day.
4. Only one other visit to the premises is required (for the purpose of reading the reaction, which can be done by simply glancing at the test animal), and much time is thus saved the practitioner.
5. The cost of the tuberculin is considerably less than in the case of the subcutaneous test.
6. A herd can be tested and retested at short intervals, and without excessive cost.

This test is now very rarely employed.

INTRADERMAL TEST.

CATTLE.

This consists in the intradermal injection of concentrated tuberculin. The injection is made with a dental syringe having a short needle.

The site usually selected is one of the caudal folds. The fold is rendered tense by elevating the tail, and 0.1 c.c. of tuberculin is injected into the substance of the dermis. A small pea-like nodule which can be felt with the finger is evidence that an intradermal injection has been made.

In a positive reaction a swelling, varying in size from a hazelnut to a pigeon's egg, appears at the site of injection in the course of twenty-four to forty-eight hours. The swelling is oedematous, slightly painful, and persists for several days. In non-pigmented skin the needle puncture is frequently seen to be surrounded by a hæmorrhagic focus.

The other fold of skin is not injected, and serves as a control.

This test may be employed simultaneously with the subcutaneous test.

PIGS.

The intradermal test is used for the diagnosis of tuberculosis in the pig. A single dose of 0.1 c.c. of concentrated tuberculin is injected into the substance of the skin at the base of the ear, where a reaction may readily be observed. In the case

of a positive reaction an œdematous swelling develops in twenty-four hours at the site of injection, and persists for several days before gradually declining. The result of the test is conveniently read at the forty-eighth hour after injection.

POULTRY.

A tuberculin prepared from the avian tubercle bacillus is used as a test for tuberculosis in poultry. A single injection of 0.2 c.c. is made into the skin of the wattle. A small tense nodule at the site of injection indicates that a proper intradermal injection has been made. A hot œdematous swelling at the site of injection constitutes a positive reaction, the uninjected wattle serving as a control. The reaction may be read at the twenty-fourth hour after injection, but it persists for forty-eight hours, and is in process of recession at the seventy-second hour.

DOUBLE INTRADERMAL TEST.

CATTLE.

This is the official test used by the Ministry of Agriculture in the Attested Herds Scheme.

The test consists in the injection into the substance of the skin of two doses of concentrated tuberculin, the dose in each case being 0.1 c.c. The injections are made with a sterile dental syringe having a short needle ($\frac{3}{8}$ to $\frac{1}{2}$ inch in length). The first injection is known as the sensitizing injection, and the second as the test or determining injection.

The site of injection is a point on the side of the neck at about its centre. It is recommended that the area of skin chosen for inoculation should be shaved, but this is not necessary. It is sufficient to clip the hair if the coat be coarse or rough, but care should be taken that the area of skin selected be clean.

Before making the injection, a fold of skin on the selected area is taken up between the thumb and forefinger, and the thickness of the fold is measured by means of callipers furnished with a graduated millimetre scale. The injection is made into the fold of skin by inserting the needle obliquely so that the point lies in the deeper layers of the dermis and does not penetrate into the subcutaneous tissue. If a proper intradermal injection has been made, a pea-like nodule can be felt with the fingers at the point of injection.

After a period of forty-eight hours the site of the first injection is again measured with callipers. The second injection is then made in the same manner as the first, the needle of the syringe being inserted so that the point lies about the centre of the pea-

like infiltration produced by the first injection. In some tuberculous animals the first injection gives rise to a definite reaction, and it is then unnecessary to make a second injection.

Twenty-four hours after the second injection, the site of the inoculation is carefully examined. In a reactor the measurement of the skin fold is increased due to the presence of an inflammatory, sensitive, oedematous swelling with ill-defined borders. The oedematous character of the swelling is of particular significance as indicating a positive reaction.

In a non-reactor the skin measurement may be increased from an initial 6 millimetres to 10 or 12 millimetres, but the swelling is clearly defined, circumscribed, firm and non-painful.

The following advantages are claimed for the double intradermal test:

1. No temperature observations are required.
2. The animals need not be kept at rest before and during the conduct of the test.
3. Interference with ordinary farm routine is not required.
4. Only three observations are necessary.
5. A small quantity of tuberculin is required for the test.
6. The test may be repeated after an interval of not less than 60 days.

MALLEIN.

Mallein is a glycerin extract of the glanders bacillus—*Pfeifferella mallei*—and is employed for the diagnosis of glanders. It is prepared by a method similar to that adopted in the preparation of tuberculin (p. 375).

INTRADERMO-PALPEBRAL TEST.

This test consists in the injection of 0.1 c.c. of mallein into the skin of the lower eyelid. A small 1 c.c. syringe (Strauss-Colin is a convenient pattern) is employed, and is fitted with a screw piston, which permits of the accurate measurement of the dose to be injected. The needles should be $\frac{1}{2}$ inch in length.

The mallein employed is a dilution of crude mallein (*malleine brute*) 1 part, with 3 parts of a 0.5 per cent. solution of phenol.

The eye must be free from all evidence of conjunctivitis. The horse is twitched, and the skin of the lower eyelid (the left eye is usually selected) is rendered tense by slight pressure exerted in a downward direction by the fingers of the left hand; the syringe is held in the right hand with the needle almost parallel with the surface of the skin, and the injection is made about $\frac{3}{8}$ inch below the margin.

If a proper intradermal injection has been made, a swelling

about the size of a split pea will appear; should the injection be made hypodermically, the reaction may be delayed, but is not materially interfered with.

A positive reaction consists in marked and very sensitive œdema of the eyelid, accompanied by pronounced ophthalmia and considerable mucous discharge. The œdema may become so marked that the eye is closed. The reaction increases in intensity, reaches its height between the twenty-fourth and thirty-sixth hour, and does not disappear for three or four days.

In the case of non-infected animals no reaction occurs, or the eyelid may present some œdema, which usually disappears within twelve hours.

The intradermo-palpebral test possesses the following advantages over the subcutaneous test, which it has practically superseded:

1. It is a much more delicate test, and a reaction can be more clearly appreciated.
2. It can be practised upon horses while they are in a febrile condition.
3. A large number of injections can be made in a very short time; the inspection of the test horses can be carried out easily and rapidly.
4. No thermometric readings are required.
5. It is much less expensive.

OPHTHALMIC MALLEIN TEST.

As in the intradermo-palpebral test, the eye must be free from all evidence of conjunctivitis.

The test consists in the instillation of 3 or 4 drops of concentrated mallein into the conjunctival sac; for this purpose an eye-dropper is employed.

A positive reaction is represented by intense ophthalmia, accompanied by a muco-purulent discharge, and frequently by œdematous swelling of the eyelids.

The reaction develops at about the fifth hour, and may continue until about the twenty-sixth hour after application.

In the case of a doubtful reaction, the test may be repeated twenty-four hours later.

A febrile condition of the test animal does not interfere with the development of the reaction.

SUBCUTANEOUS MALLEIN TEST.

The mallein employed is a dilution of crude mallein (*malléine brute*) 1 part with 9 parts of 0.5 per cent. phenol.

The application of the test consists in the subcutaneous injection

of the mallein into the side of the neck at a point about equidistant from the ear and the point of the shoulder.

A positive reaction consists in a rise of temperature and the appearance of a local swelling at the site of injection.

The temperature of the test animal is taken on the day previous to injection, again immediately before injection, and thereafter at the ninth, twelfth, and fifteenth hours. The temperature at the time of injection should not exceed 102° F.

A rise of temperature to 104° F. is generally regarded as constituting a positive thermal reaction, but provided a typical local reaction is exhibited, a temperature of 103° F. may be accepted as positive.

The local reaction consists in the appearance of a hot, painful, oedematous swelling at the site of inoculation. The swelling develops gradually, and continues to increase in size during the second twenty-four hours after injection. After reaching its maximum dimensions it gradually declines, but does not wholly disappear until three or four days after injection.

In non-glandered animals very slight reaction to the injection occurs. There may be a rise of temperature through 1° or 2° F., or a local swelling may develop, which, however, is comparatively non-painful, reaches its maximum dimensions within fifteen hours after injection, and thereafter rapidly recedes.

Should the test result in an indefinite reaction, it may be repeated after an interval of fourteen days.

JOHNIN.

Johnin is employed for the diagnosis of Johne's disease. The Johnin used in Great Britain is prepared from a culture of the bacillus of Johne's disease—*Mycobacterium paratuberculosis Johne*—by a method similar to that employed in the preparation of concentrated tuberculin. Considerable progress has been made in the preparation of Johnin of satisfactory potency and specificity.

The Johnin test is applied in the same manner as the double intradermal tuberculin test, and the interpretation of the result is based on the same criteria. The dose is 0.2 c.c. for each of the two injections. The local reactions obtained tend to be less pronounced than those effected by tuberculin. Because of the tendency of tuberculous animals to give a slight reaction to Johnin it is found advantageous to apply simultaneously a double intradermal tuberculin test.

The test has been found of considerable assistance in the eradication of Johne's disease from affected herds.

PART III

THERAPEUTICS

IN this section the more commonly encountered diseased conditions are outlined, and their general treatment indicated.

THE DIGESTIVE SYSTEM

THE MOUTH.

Stomatitis.—INFLAMMATION OF THE BUCCAL MUCOUS MEMBRANE.

Catarrhal Stomatitis may occur as a primary affection arising from the administration of irritant medicinal substances, or from the animal's licking irritant dressings, etc.; it may also be caused by the presence of mechanical irritation in the mouth. It very frequently occurs as a secondary affection in association with gastric or intestinal catarrh.

Vesicular Stomatitis of sporadic type, due to causes similar to those which obtain in catarrhal stomatitis, is met with in horses and cattle.

Mycotic Stomatitis.—THRUSH—a form of stomatitis due to the invasion of the mouth and fauces by *Oidium* *sp.*, principally affects young cattle, but also occurs in domestic birds.

Ulcerative Stomatitis commonly occurs in the dog, usually as an affection secondary to pyorrhoea alveolaris and 'canine typhus.' It is also met with as a complication in simple catarrhal and vesicular stomatitis.

TREATMENT.—*Horses and Cattle.*—Because of the difficulty in prehension and mastication, the diet should be restricted to oatmeal gruel, barley-water, linseed-tea, hay-tea, etc., until the acute symptoms subside. The animal should also be given free access to drinking water to permit of self-cleansing of the mouth. Mild astringent and antiseptic mouth-washes are indicated (boric acid, 3 per cent.; borax, 3 per cent.; potassium permanganate, 1 in 2,000; hydrochloric acid, 1½ per cent.; peroxide of hydrogen, 1 in 1 of water).

In Mycotic Stomatitis strict segregation of the affected animals, and the disinfection of their feeding utensils and drinking vessels,

must be ensured. The affected areas in the mouth should be touched with weak tincture of iodine.

In the dog, the diet should be light. The food may be largely confined to liquid nutrients. The local treatment is on similar lines to that indicated for horses and cattle.

In Ulcerative Stomatitis the ulcers may be lightly cauterized with nitrate of silver, and loose teeth should be extracted and tartar removed from the sound teeth by scaling. The *foetor oris* can be controlled to some extent by swabbing the gums and cheeks with diluted hydrogen peroxide or with eusol, 1 part to 3 or 4 parts of tepid water.

Congestion of the Mucous Membrane of the Hard Palate.—‘LAMPAS.’—Undue importance was at one time attached to this condition by laymen. It is a minor affection associated in young horses with the process of dentition, and in adult animals with digestive disturbance.

If it unduly complicate dentition, or if there be difficulty in mastication, the part may be lightly scarified with a gum lancet, care being taken to avoid wounding the palatine arteries. When associated with digestive disturbance, attention should be directed to the diet. Dental irregularities must be corrected, and an alkali such as bicarbonate of soda may be administered in the food or drinking water twice daily.

THE PHARYNX AND OESOPHAGUS.

Acute Pharyngitis—ACUTE PHARYNGEAL CATARRH—INFLAMMATION OF THE PHARYNX.

ETIOLOGY.—Acute pharyngitis in the horse is not uncommonly associated with chill, and may also occur as a complication of acute nasal catarrh, acute laryngitis, influenza and strangles. In the dog, it is met with as a complication of distemper.

TREATMENT.—The principles of treatment are similar whether the condition exists as a disease *per se* or occurs in association with other affections. From whatever cause the pharyngeal catarrh arises, it permits of the invasion of micro-organisms, and it is to such microbic invasion that the inflammation of the pharynx is due. Because of the difficulty in swallowing, draughts should not be administered, as these may provoke paroxysms of coughing, during which portions of the fluid may be inhaled, and so induce bronchial pneumonia. Medicinal agents should, therefore, be given in electuary, or in the food or drinking water. If marked febrile symptoms be present, antipyrin or acetanilide may be added to the electuary. Inhalations of water vapour, medicated with terebene, oil of eucalyptus, camphor, or compound

tincture of benzoin, assist in allaying irritation of the pharyngeal mucosa.

When there is marked difficulty in swallowing, relief is usually afforded by the application of a sinapism to the external pharyngeal region.

Phlegmonous Pharyngitis.—In this condition, the submucous tissue of the pharynx is infiltrated with a serous or hæmorrhagic effusion. Abscesses form in the submucosa, and the submaxillary lymphatic glands may become involved in the septic process. It is difficult to differentiate such cases from strangles, and the treatment is similar to that advised for that affection. It is always advisable to isolate cases of pharyngitis in young horses, as in many instances the condition is associated with strangles.

In the dog, the treatment of acute pharyngitis is similar to that for the horse. Active counter-irritants to the throat are contra-indicated, but a cataplasm composed of kaolin and glycerin, or the continued application of warm compresses to the throat, usually affords considerable relief. Because of the difficulty of swallowing, fluid medicines should be administered with care.

Chronic Pharyngitis.—This condition frequently proves resistant to treatment. If the measures advised for acute pharyngitis fail, the administration of arsenic and potassium iodide, although empirical, occasionally proves of benefit. Hygienic surroundings are of importance.

In the dog, chronic pharyngitis is a common affection; it occurs usually as a sequel to an acute attack. A solution of 1 part of weak tincture of iodine in 25 parts of glycerin, or the glycerin and tannin, may be painted over the pharyngeal mucosa. This is frequently beneficial, but should not be persisted in, as repeated applications induce retching and vomiting.

The majority of œsophageal affections met with in veterinary practice are surgical in character, and are not, therefore, considered here.

Œsophagitis varies in intensity from a superficial catarrh of the mucosa to erosion, infiltration and ecchymosis of the submucosa, and ulceration, which may even involve the muscular layer.

ETIOLOGY.—The causal factors include insufficiently diluted medicaments of an irritant or caustic nature; the presence of sharp foreign bodies, such as needles, thorns, etc.; and injuries resulting from the passage of the probang.

TREATMENT.—In cases due to the action of chemical irritants, demulcents such as linseed-tea, barley-water, etc., should be allowed *ad libitum*, and the food restricted to milk, oatmeal gruel,

etc. Astringent antiseptic electuaries, containing such drugs as potassium chlorate, myrrh, tannin, and liquorice, with honey as a basis, are beneficial. Fomentations to the region of the œsophagus may be tried. It may be necessary to resort to rectal feeding.

Œsophagismus—SPASMODIC CONSTRICTION OF THE ŒSOPHAGUS.—Œsophagismus as a functional disorder *per se* is of rare occurrence, but is very commonly associated with œsophageal obstruction, or with organic lesion such as ulceration. The condition is most commonly met with in the horse, and the attack usually develops when the animal is feeding or drinking. Its duration varies from a few minutes to several hours, and the primary attack may be followed by recurrences at irregular intervals. The spasmodic œsophageal constriction is followed by antiperistaltic movements, and the ingesta are expelled by the mouth and nostrils. The spasm and regurgitation occasion the animal much distress.

TREATMENT.—The hypodermic injection of morphine or atropine is of benefit. Chloral hydrate may be administered in enemata. It is said that the passage of the probang tends to overcome the spasm, but this procedure may actually aggravate the symptoms. In cases in which the œsophagus is obstructed by soft ingesta, however, the employment of the stomach-tube for the purpose of causing the removal of the obstruction by means of irrigation with warm water may be indicated. Warm fomentations and stimulating liniment, applied to the region of the œsophagus, assist in relieving the spasm. Preventive measures include attention to diet, and the avoidance of foods which, in a particular case, experience has shown to be likely to induce an attack.

DISEASES OF THE STOMACH

A.—The Horse.

Gastric affections are of relatively infrequent occurrence in the horse.

Acute Gastric Distension results from (1) gastric impaction due to an excessive quantity of ingesta in the stomach; (2) gastric tympany resulting from an excessive accumulation of gas. Grave danger is to be apprehended from these conditions, and that for several reasons: vomiting is of rare occurrence in the horse, and cannot be induced by emetics. In severe cases the continued distension renders the gastric musculature atonic, and gastric stimulants fail to effect the expulsion of the ingesta through the pylorus into the intestine. The equine stomach is a compara-

tively small organ, and there are limits to its distensibility. In severe cases of acute gastric tympany, the peculiar formation of the muscular fibres at the cardia prevents the egress of the accumulated gases by way of the œsophagus, while pressure upon, and occlusion of, the sigmoid flexure of the duodenum by the distended stomach prevents the escape of gas into the intestines. The stomach thus becomes practically a sealed cavity, and rupture of the organ is likely to occur unless prompt relief be afforded. Because of the position of the stomach, and the fact that it is not in immediate contact with the abdominal wall, its puncture by trocar and cannula is impracticable.

Gastric Impaction—ETIOLOGY.—This condition is commonly due to irregularity in feeding, associated with prolonged periods of fatiguing, heavy work. Under such conditions, the food is rapidly swallowed without proper mastication, and excessive quantities may be greedily taken. The use of cooked or steamed food, such as barley, wheat, and brewers' grains and the feeding of very dry fodder, especially to horses receiving an inadequate supply of water, are other causal factors.

It is conceivable that many cases of gastric impaction originate in functional disorder of the pyloric sphincter, so that it is maintained in a condition of tonic constriction, the resulting distension of the stomach leading to atony of the walls of the viscus and obliteration of the lumen of the first portion of the duodenum.

SYMPTOMS.—The symptoms in the earlier stages are those of acute discomfort rather than of pain; the animal presents a dull, sleepy appearance, and the pressure of the distended stomach upon the diaphragm may be such that the respirations become dyspnoeic and laboured.

In acute cases variable degrees of colicky pain, with considerable regurgitation and eructation, may be manifested, and the respiratory disturbance is associated with marked distress and a blundering, staggering gait. At intervals the horse may squat on his haunches, apparently with the object of reducing the intra-thoracic pressure. The spleen may be readily palpable *per rectum*, because of its backward displacement by the distended stomach.

TREATMENT consists in attempting to evacuate the mass of ingesta from the stomach, and in restoring tone to the gastric walls. A distinct advance has been made in the treatment of impaction of the stomach in the adoption of gastric lavage by means of the stomach-tube (see p. 470). This constitutes the only rational treatment. The stomach may be irrigated with a solution composed of sodium chloride, lb. ss.; formalin, ʒi.; and warm water, C.iv.

In less severe cases, a draught composed of 2 to 4 ounces of oil of turpentine or terebene and 1 ounce of tincture of ginger in linseed-oil may give relief and prevent the recurrence of tympany. In subacute cases, small repeated injections of physostigmine, pilocarpine, or arecoline are employed as gastric stimulants, but the use of such powerful purgatives, while not infrequently successful, increases the risk of gastric rupture.

When abdominal pain is present, chloral hydrate may be administered as an anodyne, since it does not reduce peristalsis, and is in itself antizymotic. It is to be realized, however, that anodynes administered by the mouth in gastric impaction may act only if they reach the duodenum, since the gastric mucosa is incapable of the absorption of drugs other than alcohol. Opiates are contra-indicated, as they inhibit peristaltic movement and constrict the pyloric sphincter. If acute colicky pains and blundering movements be present, restraint may be necessary to prevent the horse throwing himself down, since this may induce gastric rupture.

The normal tonus of the gastric walls is quickly restored upon the relief of the distension, and it is doubtful whether the subsequent administration of gastric tonics, such as strychnine, is of much value.

The after-treatment consists in rest and in attention to diet. For several days after a severe attack it is advisable to limit the ration to small quantities of light, easily digested foodstuffs.

Acute Gastric Tympany—ETIOLOGY.—Acute gastric tympany depends upon active fermentation of the gastric contents, and consequent gaseous distension. Certain foods, such as cut clover aftermath, barley and wheat, damaged grains or roots, are highly fermentable. The causal factors associated with gastric impaction may also be involved.

SYMPTOMS.—The symptoms are those of violent and continuous abdominal pain, complicated by acute dyspnoea, due to the forward pressure upon the diaphragm. The pain may be of such severity that the animal becomes uncontrollable; regurgitation of ingesta and eructation of gas may occur at intervals, but, because of the continuous fermentation, the relief afforded is inappreciable. Tympanites, as a rule, is not pronounced unless the affection be complicated with intestinal tympany. Generally the abdomen presents a rotund appearance, and evidence of tympany will be obtained on abdominal percussion in the region of the left posterior rib. The squatting posture is frequently assumed, since this affords some relief from the increased intra-thoracic pressure. Unless the gastric distension be quickly relieved, rupture of the stomach may occur.

TREATMENT is similar to that indicated for gastric impaction. The passage of the stomach-tube usually permits of the escape of the gases, and effects the immediate relief of the pain and distress. The subsequent irrigation with antizymotics (see p. 470) controls or actually arrests further fermentation. The passing of the tube may, however, be attended by marked difficulty because of the violence of the pain, and the rectal injection of chloral hydrate may require to be employed as a measure of restraint.

In less severe cases, antizymotic draughts—turpentine, terebene, carbolic acid, etc.—may be given, but the administration of draughts is usually very difficult, and their possible inhalation presents a serious risk.

If marked intestinal tympany be associated with gastric tympany, paracentesis of the intestine by means of trocar and cannula should be performed. In some cases of torsion of the double colon, the symptoms may simulate those of gastric tympany. For the differential diagnosis the reader is referred to textbooks on Veterinary Medicine.

The after-treatment of gastric tympany is similar to that advised for impaction of the stomach.

Acute Gastritis—**ACUTE GASTRIC CATARRH**—is of comparatively rare occurrence in the horse, except as a complication to influenza and other catarrhal fevers.

ETIOLOGY.—The cause of primary gastritis may be frequently referred to dietetic errors, especially when associated with prolonged periods of heavy work, to heavy infestations of parasites, notably the larvæ of *Gastrophilus equi*, and to irritant drugs.

SYMPTOMS.—In mild cases the symptoms are indefinite, and may pass unrecognized; the animal is somewhat dull and listless; the appetite is capricious; yawning is observed at intervals, and the buccal mucosa is sour smelling, dry or slimy; the conjunctiva is somewhat icteric; the bowels are irregular in action; constipation is usually present, but in some cases mild diarrhoea is evinced. The temperature is unaffected.

In more severe cases, acute discomfort or actual colicky pain may be exhibited, especially after feeding, and the condition may be complicated with some degree of gastric tympany.

TREATMENT.—The stomach should be rested, and for at least twenty-four hours the nourishment restricted to fluids—oatmeal and linseed gruels, milk, barley-water, etc. Thereafter the diet should be light and readily digestible. Gastric sedatives—bismuth, magnesia, sodium bicarbonate, belladonna—may be given in repeated doses.

In more severe cases, the tendency to flatulence can usually

be controlled by bismuth and magnesia. Should constipation be marked, the bowels should be moved by mild saline aperients—*e.g.*, small repeated doses of sodium sulphate. Oleaginous laxatives, such as linseed-oil, cause much nausea, and irritant purgatives are contra-indicated.

In gastritis due to the ingestion or administration of irritant corrosive substances, gastric sedatives with demulcents—milk, raw eggs, etc.—should be given.

Chronic (Subacute) Gastritis—ETIOLOGY.—This condition may be due to causes similar to those of the acute form. Other causal factors are imperfect mastication due to dental anomalies, over-exertion—especially when associated with malnutrition—and the ingestion of sand or other indigestible material. Sub-acute gastric catarrh may occur as a sequel to influenza.

SYMPTOMS.—The appetite is capricious, and pica, evidenced in a desire to eat clay and excrement, is frequently observed. The physical condition is gradually reduced, the coat becomes dry, and the skin loses its normal soft, pliant character. Fatigue and excessive sweating are readily induced by exertion, the pulse is usually intermittent, and the bowel action is irregular. Periodic attacks of colic may be observed, and occasionally the horse is the subject of vertigo.

TREATMENT.—It is usually desirable to commence treatment with a mild saline aperient. The food should be light and nutritious. Attention must be directed to the cause of the affection, and this, if it can be determined, at once corrected. The avoidance of undue exertion and fatigue is important. No definite line of medicinal treatment can be laid down. Alkaline gastric sedatives are usually of benefit, but the administration of acids with or without the addition of vegetable bitters may prove more suitable in individual cases. Rock-salt should be constantly available. Marked benefit usually results from putting the horse on to good pasture.

B.—Cattle.

Impaction of the Rumen.—This condition is characterized by an inordinate accumulation of ingesta in the rumen.

ETIOLOGY.—The causal factors include dietetic errors; sudden changes of food, especially from a low to a rich diet; insufficiency of water; an excess of such foods as brewers' grains, etc.; suspension of rumination, such as may result from over-driving immediately after feeding, gross over-feeding, or from penetration of the wall of the reticulum by a sharp foreign body; an atonic condition of the musculature of the rumen—*e.g.*, that which

occurs in debilitating diseases and during periods of convalescence.

The cause of the failure to evacuate the accumulated mass of ingesta is frequently obscure. It is possible that, notwithstanding the powerful contractions which the rumen is normally capable of exerting, the weight and volume of the contents are such that the rumen is incapable of movement, while the continued distension of the viscus leads to muscular atony.

Impaction of the rumen frequently complicates acute abomasitis, in which condition the movements of the fore-stomachs may be held in abeyance.

SYMPTOMS.—The onset of the symptoms is frequently sudden, but in a number of instances the affection is gradual in its development. The abdomen presents a rotund appearance, the flanks (especially the left flank) become distended, and on deep palpation of the left flank the contents of the rumen are felt as a firm pultaceous mass; appetite is lost, rumination suspended, and milk secretion decreased or actually arrested. The periodic contractions of the walls of the rumen are absent; the animal is dull, arches the back, and exhibits considerable distress, especially on exertion. There is grinding of the teeth, and groaning or grunting during expiration, especially when in the recumbent position; the respirations are accelerated; the bowels are constipated. In acute cases tympanites may be present. There is usually little or no disturbance of temperature.

TREATMENT.—Food should be completely withheld. Since absorption of drugs does not occur in the rumen, the administration by mouth of gastric and intestinal stimulants is useless. The tonus of the walls of the rumen can, however, be markedly increased by vigorous massage of the abdomen. This is performed by firmly kneading the abdominal wall with the closed fists. With the aid of an assistant, both sides of the abdomen are massaged simultaneously, and the procedure is continued for ten minutes, and repeated at intervals four or five times daily. The effects of the massage are augmented by forced but gentle exercise.

Should tympany of the rumen be in evidence, the stomach-tube should immediately be passed, or resort may be had to paracentesis. When, as the result of these measures, the acute distension is relieved, the tonus of the gastric muscle gradually re-establishes itself, and aperients (sodium and magnesium sulphate) and gastric stimulants (ammonium carbonate and *nux vomica*) may then be administered. Hypodermic injection of combinations of physostigmine, arecoline, pilocarpine, barium, and veratrine are occasionally employed, but, because of the erratic action of these

drugs in cattle, they have not been adopted in routine practice in this country. When other treatment fails, recourse must be had to rumenotomy, which permits of the evacuation of a portion of the stomach contents. Since there is some evidence that the condition may arise from a degree of hypocalcæmia and consequent lack of tonus in the musculature of the alimentary tract, subcutaneous injections of calcium-boro-gluconate have been employed in the treatment of impaction of the rumen. Certainly in a number of cases this treatment is rapidly followed by the re-establishment of active peristaltic movements.

During convalescence, bitter tonics may be given twice daily in the form of electuary. Attention to diet is necessary; small amounts of easily digested foods, such as bran-mashes, oatmeal gruel, linseed gruel, hay-tea, etc., are indicated. Limited quantities of good hay may be allowed with the object of inducing rumination.

Tympanites of the Rumen—ETIOLOGY.—Dietetic errors; the ingestion of quantities of readily fermentable foodstuffs, such as clover aftermath, especially when it is wet with rain or dew; the feeding of frozen roots or damaged fodder; sudden changes of food; the drinking of large quantities of cold water by stall-fed cows; over-driving immediately following feeding; interference with the natural regurgitation of gases, such as occurs when the animal is unable to maintain the normal recumbent position and lies prostrate on the side, or in acute oesophageal obstruction.

SYMPTOMS.—There is rapid and progressive distension of the left flank, which becomes tense and drum-like. The animal is restless, crouches, stamps its feet, and kicks at the abdomen. The respirations become distressed and laboured, because of the increasing pressure on the diaphragm and lungs; marked cardiac palpitation may be present. As the distension develops, the dyspnoea increases in severity; the nostrils are widely dilated, the mouth open, and the tongue pendulous; the visible mucous membranes are cyanotic; and the eyes are staring. Unless speedy relief be afforded, the animal reels, staggers, and falls insensible, death occurring from asphyxia. In some instances the immediate cause of death may be syncope resulting from shock. Rupture of the rumen is rare, but rupture of the diaphragm is of fairly frequent occurrence. In an acute case death may occur within thirty minutes, but the course may extend over two or three hours.

TREATMENT.—The urgency of the symptoms is such as to require the immediate relief of the gastric distension. This may be accomplished by puncture of the rumen (see p. 472). In cases

of emergency, puncture of the rumen may be performed by means of a knife, the selected site being the same as that for puncture with trocar and cannula—a point equidistant from the last rib, the external angle of the ilium, and the transverse processes of the lumbar vertebræ. The puncture should be made in a perpendicular direction.

As an alternative to paracentesis, the stomach-tube may be passed.

After the relief of the distension, antizymotics—*e.g.*, formalin—may be introduced into the rumen through the stomach-tube or the cannula, as the case may be. The insertion of a small mouth-gag facilitates eructation.

In less severe cases tympany may be relieved by the oral administration of antizymotics, antacids, and carminatives. A useful draught is composed of from 2 to 4 ounces of oil of turpentine, 2 drachms of carbolic acid, 30 minims of oil of peppermint, and 2 pints of linseed-oil. This may be followed, if necessary, by a saline purgative.

Following the action of the purgative, nerve tonics and stomachics are indicated—*e.g.*, a combination of nuxvomica, gentian, common salt, and ginger, administered in electuary three times daily. During convalescence attention to diet is necessary, and light, easily digested food should be ordered. Since there is liability to recurrence of the tympany, the attendant should be instructed in regard to the emergency application of remedial measures.

Chronic Tympanites is characterized by an habitually intermittent or persistent gaseous distension of the rumen.

ETIOLOGY.—The condition arises when the escape of the normal gases is partially or completely prevented. It may thus occur in œsophageal or intestinal stenosis, resulting from the pressure of enlarged tuberculous glands or neoplasms in the thorax or abdomen. It also arises from interference with the movements of the rumen, such as may result from the presence of foreign bodies in the fore-stomachs; or from traumatic gastritis, due to the penetration of a sharp body through the wall of the reticulum. Recurrent tympanites is also associated with functional disorder of the fore-stomachs, such as may complicate acute abomasitis.

SYMPTOMS.—The acute symptoms usually develop shortly after feeding, and the tympany is generally moderate in degree. Rumination is very irregular; the appetite is capricious, and frequently depraved; loss of physical condition is progressive.

TREATMENT.—The cases in which medicinal measures are likely to prove of service are those depending upon atony of the walls of the rumen, and its consequent functional derangement. When

this is associated with acute tympanites, the treatment is that indicated for that condition. In other cases the gastric atony is combated with tonics and nervine stimulants—strychnine, ammonium carbonate, and bitters combined with alkalies—and antizymotics may be employed to control the tympany. If the accumulation of gas becomes excessive, the trocar and cannula should be employed, and in a number of cases the cannula must be kept *in situ* for prolonged periods, as otherwise tympany rapidly recurs.

Attention to diet is necessary; this should be sparse in amount and easily digested—e.g., bran-mashes, demulcent drinks, and a moderate quantity of good hay. Bean or pea meal should be avoided.

In refractory cases a prolonged course of treatment is rarely justifiable; it is better practice to perform an exploratory rumenotomy with the object of determining, if possible, the cause of the tympany. The destruction of the animal with a view to salvage of the carcase is usually the most economic course.

Impaction of the Omasum.—There is considerable difference of opinion with reference to the occurrence of impaction of the omasum as a primary condition. It is generally agreed that a primary acute abomasitis is commonly complicated by atony and impaction of the omasum; but the condition, if it exist *per se*, presents no symptoms by which it may be differentiated from abomasitis.

Acute Abomasitis.—**ACUTE GASTRITIS**—**ACUTE DYSPEPSIA.**

ETIOLOGY.—Abomasitis may be due to the action of chemical or other irritants, or to the heavy infestation of nematode parasites, but these are relatively uncommon causal factors. The condition frequently arises without obvious cause, and is then commonly referred to 'chill.' It is probable that many such cases are due to catarrh of the gastric mucosa predisposing to bacterial invasion. Primary disorder of the movements of the fore-stomachs, with consequent irregular passage of ingesta, may lead to catarrh of the abomasum.

SYMPTOMS.—The onset of the attack is usually sudden. There is dulness, anorexia, cessation of rumination, and a variable degree of pyrexia—from 102° to 106° F.; the stance is suggestive of acute discomfort, the head is held low, the back is arched, and sudden movement or continued exertion is accompanied by moaning or grunting. The action of the bowels is irregular, constipation is usually in evidence, but may give way to profuse diarrhoea. Milk secretion is arrested; tenderness may occasionally be elicited upon pressure over the region of the abomasum.

The inaction of the fore-stomachs, which commonly complicates

abomasitis, may be protective in character, in so far that it reduces, if it does not prevent, the introduction into the abomasum of irritant ingesta; but, as a result of this occurrence, impaction or tympany of the rumen may ensue.

TREATMENT.—The presence of acute gastric discomfort, the constipation and the impaction, or tympany, of the rumen suggest the employment of purgatives, but, since these symptoms primarily depend on inflammation of the mucosa of the abomasum, the use of irritant purgatives is contra-indicated. Oleaginous laxatives are also contra-indicated, especially in the early stages, because the irregular and capricious rumination is discouraged by the regurgitation into the mouth of ingesta containing a nauseous oil. Saline purgatives are useless, since, although, after reaching the abomasum and small intestine, they are capable of stimulating peristalsis, which may be reflexly referred to the fore-stomachs, they are inactive, because they cannot pass from the inert, impacted rumen.

The animal should be fasted, but demulcent drinks may be allowed. Should impaction of the rumen be marked (p. 391), this should be controlled by massage conjoined with gentle exercise. The bowels may be stimulated by enemata. The movements of the fore-stomachs can be markedly increased by the hypodermic injection of physostigmine sulphate in small repeated doses.

After rumination has been re-established, small quantities of light, easily digested food (freshly mown grass, good hay, and even succulent roots) should be allowed. Such foods are given with the object of stimulating rumination rather than of providing nourishment. Thirst may be stimulated by the use of saline electuaries and salt-licks, and demulcent drinks are now freely permissible. Gastric sedatives—bismuth, belladonna, hyoscyamus—with alkalies, are indicated, and as the case progresses the diet may be gradually increased.

During convalescence a combination of ammonium carbonate with nux vomica and other bitters is commonly prescribed with the object of restoring the normal gastric tonus and secretory function. Although such treatment is generally believed to be beneficial, its value is somewhat doubtful, and the use of irritants, such as carbonate of ammonia, may be actually contra-indicated.

Parasitic Gastritis occurs in young cattle and in sheep, and depends upon the infestation of the abomasum with nematodes, among the most important of which is *Hæmonchus contortus*.

TREATMENT primarily consists in the administration of suitable anthelmintics. For this purpose the copper-nicotine mixture and also phenothiazine have proved valuable agents (see pp. 143, 221).

Dyspepsia.—Indigestion or dyspepsia is a common affection, especially in milch cows.

ETIOLOGY.—Many cases can be traced to dietetic error. The affection may also result from chill and exposure. It is commonly met with in richly fed milch cows, which have been closely confined for prolonged periods in the stall, and is, therefore, more usually encountered during the winter season.

SYMPTOMS.—The appetite is capricious and rumination imperfect; the action of the bowels is irregular; milk secretion is decreased or arrested; the coat becomes harsh and rough, the skin loses its soft pliant quality, and tends to adhere to the subcutaneous tissue ('hide-bound'). Impaction and intermittent tympany of the rumen, resulting from the irregular action of the fore-stomachs, not uncommonly complicate the condition. There is usually little or no disturbance in temperature.

Imrie expresses the opinion that a number of cases of dyspepsia are traumatic in origin, in that they result from the penetration of the wall of the reticulum by a sharp foreign body. In such conditions, apart from the symptoms of acute dyspepsia, the temperature is usually elevated, and in a proportion of cases the presence of gas in the peritoneal cavity can be detected by palpation of the left flank over the rumen. The animal is disinclined to move, and exertion is accompanied by a painful grunt.

TREATMENT.—Fodder should be totally withheld, or the diet may be limited to light, easily digested food, and demulcent drinks may be allowed *ad libitum*. A mild saline aperient, followed by alkaline stomachics, is beneficial. Other treatment is symptomatic.

In dyspepsia of traumatic origin, Imrie recommends that the body be elevated anteriorly. This is accomplished by arranging a wooden platform about 6 feet long by 3 or 4 feet wide and 12 inches high, upon which the fore-feet of the animal stand. Spars may be fixed to the platform to prevent the feet from slipping. The rationale of the procedure is based upon the hypothesis that by elevating the anterior portion of the body, the gastric walls tend to fall back from the diaphragm, carrying with them the penetrating body, the separation of the reticulum from the diaphragm being effected by the presence of gases in the peritoneal cavity. While this view may not receive general acceptance, it can be said that the treatment frequently proves of eminent value.

Pica—**DEPRAVED APPETITE**—is frequently met with in pregnant and lactating cows. The affected animals lick the walls and floors of the byre, and may eat earth and soiled litter. The conditions upon which pica depends are obscure, but it is frequently indicative of mineral deficiency in the diet. The

affection often rapidly responds to the administration of mineral mixtures containing calcium, sodium, magnesium, iron, and phosphates.

Post-Parturient Dyspepsia—**POST-PARTURIENT ACETONÆMIA**—is an affection encountered in dairy cows about ten to fourteen days subsequent to calving. The affected animals are commonly between four and ten years of age, and are almost invariably stall fed.

ETIOLOGY.—The pathogenesis is obscure, but the acetonæmia which is invariably present indicates the occurrence of incomplete fat metabolism. This, in turn, may be related to the hypoglycæmia which can usually be demonstrated. The apparent benefit which occasionally follows mammary inflation has led to the suggestion that the affection represents a form of delayed milk fever, but in post-parturient acetonæmia the blood-calcium values are within the normal range.

SYMPTOMS.—The appetite is markedly reduced, and may be completely lost, but pica is commonly exhibited; there is much depression of spirits, and general dulness; rumination is slow and irregular, and may be interrupted by pauses of several minutes' duration. The bowels are constipated, and the fæces are dry, dark in colour, and covered with a thick, dark, tenacious mucus. The odour of acetone is early evident, and is exhaled from the breath, milk, and skin. The presence of ketone bodies (β -oxybutyric acid, diacetic acid and acetone) in the urine can be readily demonstrated by Rothera's test (see p. 38).

TREATMENT consists in the administration of a saline aperient. This is followed by alkalis in large quantity—*e.g.*, sodium bicarbonate in doses of 12 ounces by mouth or 2½ ounces in a 12 per cent. aqueous solution intravenously for the purpose of combating the acidosis; also readily assimilable carbohydrates (glucose and treacle) with the object of facilitating the complete combustion of fat. Solutions of glucose may also be given subcutaneously, preferably combined with insulin (p. 356). Mammary inflation may be tried, but the injection of readily assimilable salts of calcium appears to possess little, if any, beneficial influence. *Liquor formaldehydi*—2 to 4 drachms—diluted with 1 to 2 gallons of normal saline, administered by stomach tube and repeated daily, constitutes an empirical treatment. In subacute cases, the administration of a mild saline aperient, followed by a course of alkalis and stomachics, often succeeds. In all cases, marked benefit follows when the patient can be put out to graze on good pasture.

Dyspepsia in Calves—**GASTRO-INTESTINAL CATARRH.**—This condition occurs most commonly in hand-reared calves. It is

characterized by catarrh of the abomasum, which contains large firm masses of curdled milk, and is usually associated with a varying degree of intestinal catarrh.

ETIOLOGY.—Excessive allowance of rich milk, irregular feeding, the use of milk from cows suffering from febrile conditions, especially mastitis; the addition to the milk of unsuitable food-stuffs, improper cleansing of feeding utensils, etc.

SYMPTOMS.—The symptoms are those of marked dulness, anorexia, progressive and rapid loss of physical condition, constipation, soon succeeded by profuse and foetid diarrhoea, occasional moaning and restlessness, and a varying degree of tympany.

TREATMENT.—The cause should, if possible, be removed or corrected; a saline aperient is therefore indicated. One ounce of sulphate of soda, 2 drachms of bicarbonate of soda, and $\frac{1}{2}$ drachm of powdered ginger, given in $\frac{1}{2}$ pint of tepid water and repeated after an interval of twenty-four hours, or 2 to 3 ounces of castor-oil combined with chlorodyne, may be given. When diarrhoea is severe, small doses of terebene, combined with chlorodyne and administered in boiled milk, prove useful.

When tympany of the rumen is present, this may be controlled by the administration of 20 minims of formalin, well diluted with water. In less acute cases, the addition of one wineglassful of lime-water to each quart of boiled milk is of benefit. Brandy or port wine in boiled milk is useful when a combined stimulant and astringent action is desired. The animal must be kept warm, and carefully nursed.

C.—The Dog.

Acute Gastric Dyspepsia—**ETIOLOGY.**—Dietetic error; secretory disorder resulting in deficiency in hydrochloric acid and pepsin; atony of the gastric musculature. Deficiency in secretion and in gastric peristalsis may be associated with the general enfeeblement which is present during convalescence and in debilitating diseases. If the food, from any cause, be not perfectly digested in the stomach, then the undigested proteins ferment and are converted into organic acids with the evolution of gas.

SYMPTOMS.—Dulness, loss of appetite, foetor oris; the buccal mucosa is dry or slimy, the stomach contents are readily vomited; in many instances the vomitus is almost immediately reingested, and other symptoms of pica are commonly evinced. Thirst is often a prominent symptom; some degree of constipation is usually present; the temperature is unaffected.

TREATMENT.—The stomach should be rested for from twelve to twenty-four hours by withholding food, and allowing only small quantities of iced barley-water. A small dose of grey powder combined with carbonate of magnesia, or small doses of the compound rhubarb powder repeated twice daily, are useful. In cases associated with debility, fats and rich nitrogenous foods should be avoided; but the gastric movements and secretions may be stimulated by allowing *very small* quantities of fresh, minced raw beef. The diet should be of a light, easily digestible nature—milk, white fish, etc. Alkaline and bitter stomachics—given before food—are also indicated. In cases characterized by excessive secretion of acid (hyperchlorhydria), in which condition periodic attacks of dyspepsia are evinced about two to three hours after feeding, antacids (as distinct from alkaline stomachics), and gastric sedatives—calcined magnesia and bismuth—are given after feeding. Irritant drastic purgatives are contra-indicated and, while the use of liquid paraffin as an aperient is permissible, castor-oil is liable to produce severe nausea and vomiting.

Acute Gastritis.—ACUTE GASTRIC CATARRH.

ETIOLOGY.—Dietetic error, resulting in the presence of highly indigestible matter in the stomach, is generally regarded as a fruitful source of gastric catarrh, yet the vomiting reflex is readily induced in the dog, and he is thus able to reject deleterious foodstuffs with facility. Probably for this reason gastritis can rarely be referred to the ingestion of unsuitable food. That gastric catarrh can arise as the result of the ingestion of chemical irritants, and from the presence of large numbers of ascarides in the stomach, can be readily understood; yet these, as causes of gastritis, are of comparatively rare occurrence. Gastritis, in the dog, is usually a secondary affection associated with certain specific infections, such as distemper, and with other catarrhal affections of indeterminate nature.

SYMPTOMS.—Dulness and lassitude, with capricious appetite, may be evinced prior to the acute attack, which is ushered in by vomiting accompanied by retching and distress; the vomitus consisting of frothy mucus, which may be bile-stained. The dog becomes lethargic, but prefers to lie on cold surfaces, and assumes a variety of postures, especially lying with the belly in contact with the floor or ground. There is marked thirst, and if cold water be allowed in quantity, it is eagerly taken, but is soon vomited. Pressure in the region of the epigastrium commonly elicits signs of pain, and the abdominal wall contracts under palpation. The mouth is dry and foetid, and deposits of dark coloured sordes accumulate on the teeth and gums. Anorexia

is complete. Constipation is usually present, but if the condition be complicated by enteritis, profuse diarrhoea supervenes. The pulse is rapid and hard in quality. The temperature is variable, but is usually febrile.

In severe cases, within twenty-four to forty-eight hours the bodily weakness becomes extreme, and the physical condition is rapidly reduced. The temperature falls, the surface and especially the extremities of the body become cold. The pulse is weak and becomes progressively imperceptible. Finally coma develops, and death occurs as the result of collapse.

The symptoms of chronic nephritis, a condition of common occurrence in adult dogs, closely simulate those of acute gastritis. The emesis in nephritis results from the effect on the vomiting centre of the toxæmia that develops as a consequence of the failure of renal function. An unusually strong pulse is a characteristic feature of chronic nephritis. For the purpose of differential diagnosis, a urine analysis should be made (see p. 35).

TREATMENT.—It is necessary to control the emesis, because of the distress and exhaustion which it induces. Anti-emetics and gastric sedatives are therefore indicated—*e.g.*, bismuth, chloretone, chlorodyne, small quantities of iced water. In order to afford the stomach complete rest, nourishment may be limited to nutrient suppositories. After the vomiting has been effectively controlled, small quantities of a mixture of milk and lime-water, or soda-water, may be allowed. Beef extract, prepared by macerating for a few hours finely minced beef in its own volume of cold water, is often relished, but should be given in small amounts. It is important to endeavour to induce the patient to take food voluntarily, and forced spoon feeding should be avoided. Warm applications to the abdomen frequently yield a measure of relief. Purgatives are contra-indicated, but the action of the bowel may be assisted by glycerin suppositories. Threatened collapse may be combated by hypodermic injections of caffeine and sodium benzoate or of camphor.* Alcoholic stimulants are, as a rule, to be avoided. Further medicinal treatment is symptomatic in character, but the maintenance of body warmth, and attention to the patient's general comfort, are in all cases highly important.

Subacute Gastritis—SUBACUTE GASTRIC CATARRH.—The symptoms and treatment of subacute gastric catarrh are similar to those indicated for gastric dyspepsia. The vomiting is, however, more persistent, and may require special measures for its control.

Many cases of chronic nephritis closely simulate subacute gastric catarrh, and urine analysis is necessary to permit of a differential diagnosis.

Foreign Bodies in the Stomach.—This subject properly lies within the province of surgery, as the treatment consists mainly in operative measures. Foreign bodies are frequently swallowed by dogs, especially by young animals. Portions of cork or sponge, collections of hair, rubber balls, stones, etc., prove very dangerous.

SYMPTOMS.—If the foreign body be such as to be incapable of penetrating the gastric wall, and if it remain free in the stomach, no symptoms may be manifested. It may, however, lead to attacks of vomiting and retching, accompanied by nausea and listlessness. If the body penetrate the viscus, or if it become lodged in the pylorus, the condition is surgical. Not infrequently epileptiform convulsions of a reflex nature result from the visceral irritation induced by the presence of the foreign body. In arriving at a diagnosis, the history of the case is important; but the owner not infrequently imagines that the dog has swallowed a foreign body, when it is not, in fact, so.

TREATMENT.—Hobday advised that in cases in which small bodies, such as nails, etc., have been swallowed, food which is likely to surround them and cause them gradually to pass along the intestine should be ordered, and for this purpose he recommends suet pudding. When the foreign body is not sharp, an emetic, preferably apomorphine, may effect its expulsion; even large bodies can be safely expelled by this means. In cases in which surgical interference appears to be indicated, it may be desirable that the patient should first be submitted to an X-ray examination.

DISEASES OF THE INTESTINES.

A.—The Horse.

Diseases of the intestines in the horse are of very common occurrence. The number and variety of these affections and the difficulty encountered in their differential diagnosis render the subject of great importance to the clinician; but in this book the principles of treatment can be discussed only in a general manner.

When it is possible to diagnose accurately the presence of volvulus or other fatal intestinal conditions, the speedy and humane destruction of the patient is the proper course to adopt, since we do not possess practicable means whereby their remedy can be effected; but the symptoms of these conditions are frequently such that we cannot arrive at a precise diagnosis, and it is not uncommon to encounter cases which make complete recovery, although the prognosis was distinctly unfavourable. A recognition of this fact leads the practitioner to exercise extreme

care in arriving at a diagnosis and prognosis, and in prescribing medicinal treatment.

Colic.—The term 'colic' is loosely applied to a variety of conditions in which the patient presents abdominal pain as a leading symptom. Colic should, however, be regarded as a symptom rather than as a pathological entity, and the evidences of abdominal pain can, with propriety, be described as 'colicky' symptoms.

Apart from gastric and intestinal affections, colicky pains may be manifested in diseases of the liver, kidneys, and in the early stages of pleurisy and of so-called "azoturia" (myoglobinuria).

Simple or Spasmodic Colic.—ETIOLOGY.—Spasmodic colic is a functional disorder depending on periodic spastic contraction of the muscular layer of the intestines. It is commonly caused by the presence in the bowel of irritating ingesta which may result from imperfect digestion, and is frequently met with in horses that have been subjected to prolonged periods of fasting during work, especially if a heavy feed be offered upon return to the stable. In such cases the animal eats greedily; the improperly masticated food acts as an irritant, and the bowels, as the result of a local enteric reflex, are thrown into irregular and violent spastic contractions. The mass of ingesta, instead of being subjected to the rhythmic movements occasioned by normal peristalsis, becomes segmented, and large portions may become arrested in those parts of the bowel which are relatively quiescent. The condition may thus proceed to impaction of the large colon, which results from a local tonic contraction of the bowel wall upon an impacted mass of ingesta; or volvulus, due to the violent and irregular intestinal movements, may occur. While spasmodic colic is in itself a simple condition, the possibility of its proceeding to volvulus or to intestinal impaction must, therefore, be recognized.

SYMPTOMS.—The symptoms of spasmodic colic are described on p. 23.

The intermittent character of the pain, the absence of disturbances of temperature and pulse, except during the painful paroxysms, constitute the leading features of the affection. The practitioner may be hurriedly summoned to a case of this kind in which rather violent symptoms were manifested, to find upon his arrival that the patient has recovered spontaneously.

TREATMENT.—In many instances, the administration of a simple diffusible stimulant (sweet spirits of nitre) or an anti-spasmodic (chlorodyne combined with tincture of ginger) will afford relief. The oil of turpentine, in doses of 2 ounces in 1 pint of linseed-oil, often restores normal peristaltic movement. If the pain be severe, chloral hydrate dissolved in water

may be added. The application to the abdomen of hot compresses and fomentations (see p. 178) often yields a measure of relief. Opiates, although antispasmodics, are contra-indicated (see p. 232).

With the object of assisting the removal of the irritant ingesta, a saline aperient combined with a carminative should be administered. Aloes in solution is also useful for this purpose, but possesses the disadvantage that, after its administration, the horse cannot be safely worked for several days. Soap enemata aid the action of the aperient.

Intestinal Tympany—FLATULENT COLIC.—Flatulent colic depends upon the presence of an excessive accumulation of gases, especially in the large colon, originating as the result of the ingestion of unsuitable and readily fermentable foods. Occasionally tympany involves the stomach and intestines simultaneously.

Tympanites of the abdomen in varying degree of intensity is met with as a symptom in intestinal obstruction, especially during the later stages, and in rupture of the stomach or intestine, in peritonitis and in enteritis.

SYMPTOMS.—The onset is usually sudden. In the earlier stages, pain is frequently violent and intermittent, but as tympany progresses the pain becomes continuous, although it is not manifested by such acute symptoms. The abdomen becomes distended, and is tense on palpation. Upon percussion, marked resonance is elicited over extensive areas. Because of the mechanical pressure upon the diaphragm, respiration becomes dyspnoeic, and there is much general distress. The animal assumes a crouching attitude, and makes frequent attempts to lie down before eventually doing so; but the recumbent position is not long maintained, as it considerably increases intra-abdominal pressure. The pulse is quick and wiry, later becoming weak. The visible mucosæ are congested; there is profuse localized sweating. Later the surface temperature, especially that of the extremities, markedly falls. Rectal examination readily reveals the tympanitic bowel. In extreme cases, unless early relief be afforded, a fatal termination soon results. Death may occur from asphyxia, rupture of the intestine, or, more rarely, rupture of the diaphragm.

TREATMENT.—In severe cases the urgent symptoms consequent upon the intense tympanites should be at once relieved by puncture of the intestine (see p. 471). Antizymotics and antispasmodics are then administered in conjunction with an aperient—*e.g.*, aloes or saline—with the object of controlling further fermentation, and of removing the mass of fermenting

ingesta. If pain be severe, a full dose of chloral hydrate—which is itself antizymotic—may be added. Powerful purgatives, such as arecoline, physostigmine, and pilocarpine, are valuable in effecting rapid expulsion of the contents of the large colon, but they should not be given until the acute tympany be relieved. Enemata of soap and warm water augment the action of the aperient. In less severe cases, paracentesis may be unnecessary, and medicinal treatment may suffice to effect recovery.

As a rule, it is proper to permit the subject of acute colic very considerable freedom of action. He can thus adopt postures which will afford him some measure of relief from the pain, but in cases of acute intestinal tympany restraint may be necessary in order to prevent the animal from throwing himself down violently, and so inducing rupture of the bowel.

During convalescence, attention to diet is necessary. Horses that are subject to flatulent colic should be allowed proper rest after feeding. The teeth should be examined in order to detect and, if necessary, remedy dental irregularities.

Subacute Obstruction of the Large Colon.—Intestinal obstruction may be due to mechanical displacements, such as those of volvulus and intussusception, but as distinct from these, the obstruction frequently results from impaction of ingesta.

Intestinal Impaction—ETIOLOGY.—The impaction may occur, as a sequel to an attack of spasmodic colic (*q.v.*). The ingestion of large amounts of dry fodder, an insufficient allowance of water, improper systems of general management and feeding, are predisposing causes.

The immediate cause of the impaction is a localized tonic spasm of the bowel wall. When intestinal peristalsis is markedly irregular, some portions of bowel are relatively quiescent, while others are thrown into violent contractions, and as a result of these erratic movements the semi-solid ingesta of the large colon are irregularly distributed, and masses of ingesta tend to accumulate, especially at the flexures, which present natural impediments to the free passage of the bowel contents. This is particularly evident at the pelvic flexure, which marks a sudden diminution in the lumen of the gut (it being the junction of the wide second portion and the relatively narrow third portion of the large colon). The localized accumulation of ingesta causes marked distension of the irritable gut muscle, which, as a result, contracts powerfully upon the impacted mass.

SYMPTOMS.—When intestinal impaction occurs as the immediate sequel to spasmodic colic, the pain is violent and almost continuous, and is associated with marked acceleration of pulse-rate, sweating, and general disturbance. If the impaction be

in the region of the pelvic flexure, it is readily felt on rectal exploration, and the spastic condition of the bowel may be determined by manual palpation.

When the condition depends upon bowel stasis and the consequent gradual accumulation of ingesta, the symptoms are insidious in their onset, and colicky pains may not be observed until actual impaction occurs. The animal is dull and listless, and the appetite is reduced. These symptoms may be in evidence for twenty-four to forty-eight hours before the occurrence of dull abdominal pain (see p. 24). The horse may press the hind-quarters against an accessible fixed object, and exhibit considerable tenesmus. Occasionally a varying degree of intestinal tympany complicates the impaction. On abdominal auscultation, the borborygmi are found to be reduced in their number and force. The rectum is frequently 'ballooned,' and the impacted bowel is usually readily palpable. Rectal exploration frequently occasions marked straining and efforts at defæcation. The abdominal pain is persistent and increases in intensity, and constitutional disturbance, which at first was little in evidence, now becomes apparent. The pulse progressively increases in rate, the visible membranes become congested, the respirations are increased, and in severe cases assume a sobbing character. The temperature may remain relatively undisturbed, although paroxysms of pain occur at intervals.

In fatal cases, the duration of the attack usually varies from thirty-six to forty-eight hours, but the course may extend over a period of several days. In favourable cases, recovery may be obtained in twenty-four to forty-eight hours.

TREATMENT.—Since the pain depends upon enteric spasm, and because this in turn is due to distension of the gut muscle upon the impacted mass, the treatment consists in evacuating the impacted bowel. A saline aperient, such as sodium sulphate, increases the fluidity of the bowel contents, and quantities of hypertonic saline solution administered by stomach-tube also fulfil this purpose. Arecoline, physostigmine, pilocarpine, or aloes in solution are frequently employed. When pain is severe, chloral hydrate is indicated. The powerful antispasmodic volatile oils—turpentine and peppermint—may be given in conjunction with the aperient.

The antispasmodic actions of belladonna and opium were at one time largely employed, but, as has been indicated, it is the impaction and not the spasm upon which the pain primarily depends, and opium, while admittedly a powerful antispasmodic, may so paralyse the bowel that it fails to respond to the action of aperients.

There are occasions, however, when, because of the intensity of the spasms and the violence of the pain, it is improper to confine our efforts to the removal of the impaction, since the administration of powerful cathartics may cause very severe exacerbation of the pain, or may actually induce intestinal rupture. In such cases it should be our first object to overcome the spasm; this may be effected by administering large doses of belladonna or cannabis indica, which, while powerful antispasmodics, do not induce intestinal inertia.

Oleaginous agents, while useful as vehicles for irritant drugs, such as chloral hydrate, are unsuitable aperients in impaction colic, because their action is slowly produced and is accompanied by very considerable nausea. Caulton Reeks advises the administration of large doses of nux vomica and carbonate of ammonia (p. 121), for the purpose of restoring tonus to the gut muscle. While ammonium carbonate may be an intestinal stimulant because of its local irritant action, it is doubtful whether nux vomica is capable of so markedly increasing the tonus of the intestinal muscle that it can be regarded as an active aperient. In a number of cases, considerable relief is afforded by massage *in recto* of the distended spastic bowel.

During convalescence, no special medicinal treatment is ordinarily required when the impaction has been removed and the normal intestinal peristalsis is completely re-established, but the animal must not be put to work until complete recovery has been attained.

Impaction of the Cæcum.—This condition has proved remarkably resistant to treatment; the employment of purgatives, and the administration of large quantities of fluid by stomach-tube, are equally useless. Powerful anodynes and antispasmodics may be tried. They at least relieve the animal's pain, and overcome the spasm of the cæcal walls, with which the impaction is associated.

Impaction of the Small Colon.—The treatment is on similar lines to that for impaction of the large colon, but copious enemata of warm water are specially indicated.

Volvulus—INTESTINAL OBSTRUCTION DUE TO DISPLACEMENT OF THE BOWEL.—Volvulus is the most common cause of death in equine colic, and may involve either the large or small intestines. In volvulus of the large intestine, torsion may occur around the long axis of one or more portions of the bowel. Torsion also commonly involves the pelvic flexure, or, more rarely, the diaphragmatic flexures. In the small intestine a loop of bowel may become twisted, or may herniate through a rupture in the mesentery. Volvulus is said to be partial or complete according

to the degree of strangulation of the mesenteric vessels which obtains.

ETIOLOGY.—The cause is frequently obscure, but in the majority of cases its occurrence is believed to be due to irregular and violent movements of the intestines. Thus, as has been indicated, it not infrequently complicates an attack of simple spasmodic colic (*q.v.*).

SYMPTOMS.—The symptoms depend upon the degree of displacement. In incomplete volvulus of the large intestine, the pain in the earlier phase is continuous and subacute in character, although acute paroxysms may occur. The pulse is frequent, hard and wiry; the respirations are accelerated; the conjunctiva is injected, and the temperature is raised. The fæces are usually passed in small quantity. On rectal exploration the rectum is tightly constricted upon the hand and arm, and the examination is accompanied, and may be followed, by considerable tenesmus. The pelvic flexure of the large bowel may not be capable of recognition by palpation, as it is commonly displaced from its normal position at the pelvic brim. Intestinal tympany is usually present.

The case commonly runs a course of from twenty-four to seventy-two hours before terminating fatally.

If volvulus be complete, the pain is continuous and intense, and the systemic disturbance which is exhibited is more pronounced than in partial volvulus. During the latest phase of the attack signs of pain may suddenly disappear, but the pulse becomes rapidly imperceptible, and the general symptoms are those of imminent collapse. The sudden cessation of pain is believed to be due to necrosis of the affected portion of bowel. The standing posture is usually maintained until immediately before death, which commonly ensues in from ten to twenty-four hours.

For the differential diagnosis of volvulus the reader is referred to textbooks on Veterinary Medicine.

TREATMENT.—In a considerable proportion of cases the condition cannot be differentiated with certainty from that of acute impaction of the large colon, but in those cases in which a precise diagnosis can be made, the pain should be controlled by the exhibition of powerful narcotics. There is at present no known means by which the displacement can be reduced.

Obstructive Colic in Foals.—**ETIOLOGY.**—The obstruction depends upon the presence of hardened masses of meconium in the single colon, or the rectum, and the symptoms may develop very shortly after birth.

SYMPTOMS.—The animal is restless and uneasy, and periodi-

cally exhibits acute abdominal pain. Frequently ineffectual attempts at defecation may be made, and the dam is suckled listlessly. Unless relieved, the painful symptoms become more violent, and death occurs after a short course of illness.

TREATMENT.—When colicky pains occur in a foal, a digital exploration of the rectum should always be made. Should rectal impaction be present, the impacted mass must be carefully broken down and removed by the finger, assisted by a blunt surgical spoon (a bone egg-spoon serves the purpose). Copious warm-water enemata should then be given by means of a gum-elastic rectum-tube attached to a rubber bulb syringe. This assists in the softening and disintegration of the obstruction. Care must be observed to avoid injury, but the enemata should be repeated until the bowels act normally.

This treatment may be supplemented by the oral administration of liquid paraffin or castor-oil. If the pain be severe, spirit of chloroform, or a small dose (20 grains) of chloral hydrate, may be given in milk; opiates should be avoided. Attendants upon foals should be informed of the urgent need of professional assistance in cases of colic.

Intestinal Calculi.—Intestinal calculi may attain remarkable weight and size; their formation is commonly of long duration, and may extend over a period of years without the occurrence of appreciable illness. Horses the subjects of intestinal calculi may, however, experience periodic attacks of violent colic. Such attacks are believed to depend upon the displacement of the calculus from its nidus, with resultant localized spasm of the bowel wall. Very occasionally the calculus can be discovered by rectal exploration, and if within reach of the hand, can be removed. Small calculi in the single colon or rectum may be expelled after the administration of copious enemata by means of a long rectum-tube, but such cases are of very exceptional occurrence. Active purgatives—physostigmine, etc.—are contra-indicated, as, although they may effect the replacement of the calculus by inducing violent peristaltic movement, rupture of the bowel may result from their use. Anodynes and antispasmodics should be administered for the purpose of overcoming the enteric spasm and permitting the spontaneous replacement of the calculus.

Enteritis.—INFLAMMATION OF THE INTESTINE.

ETIOLOGY.—Inflammation of the intestines may result from the presence in the bowel of chemical or mechanical irritants, or may occur as a complication of acute infectious fevers—*e.g.*, influenza—but the condition here discussed occurs as a clinical entity of obscure causation. The fact that enteritis with similar clinical manifestation may occur as a complication to anthrax has led to

the assumption that the condition represents an acute bacterial infection.

SYMPTOMS.—The onset is usually sudden, and is characterized by rigor. The temperature is raised several degrees; the pulse is accelerated, hard and wiry; the fæces are at first small in quantity and dry in consistency, although they may be frequently passed. Dull but persistent pain is observed. The pain and general systemic disturbance then increase in intensity, and are accompanied by profuse diarrhoea. The abdominal walls are contracted and tense on palpation. A variable degree of tympany may be present, sweating is profuse, and the conjunctiva intensely congested. The abdominal pain is intense, shows no intermission, and exhaustion becomes extreme. The pulse is rapid and almost imperceptible. The extremities become cold, and muscular tremors develop over the triceps and gluteal muscles.

In the final stages all evidence of acute pain may subside, due to necrosis in the affected portion of the bowel; the animal stands persistently; if made to move, the gait is staggering and blundering, and he falls and dies after a few convulsive struggles. The duration of the course is usually from eight to twenty-four hours.

TREATMENT.—No remedial treatment is known. The pain is relieved by the administration of large doses of powerful narcotics.

Diarrhoea—ETIOLOGY.—Diarrhoea is indicative of intestinal irritation. This may arise from dietetic error, intestinal helminthiasis, the presence of chemical irritants, catarrh of the intestinal mucosa, etc. The frequent passage of soft, even semi-fluid fæces is commonly observed in nervous, excitable horses. Diarrhoea is, therefore, a symptom dependent upon a number of diverse causes.

TREATMENT.—When due to the presence of irritant ingesta, a mild aperient should first be given, but irritant purgatives are contra-indicated. The horse must be kept at rest; boiled starch or flour gruel should be allowed in limited amounts, and unless the diarrhoea be profuse, a small quantity of hay may be given. Cold water should be restricted. Powerful astringents should not be given, but, if the diarrhoea persist, mild astringents—chlorodyne with wheat-flour gruel—may be administered in repeated doses. Should marked depression be present, brandy may be added.

After an attack of diarrhoea the horse must not be put to work until complete recovery is established, otherwise the condition is likely to recur, or untoward complications supervene.

Superpurgation.—Superpurgation is an aggravated form of diarrhoea, due to an acute muco-enteritis, and characterized by excessive, continuous purging, associated with serious constitutional disturbance.

ETIOLOGY.—The presence of intestinal catarrh in the horse readily predisposes to the inordinate action of irritant purgatives—*e.g.*, aloes. For this reason, purgatives are entirely contra-indicated in febrile catarrhal affections, such as coryza and influenza. Debility, whether arising from malnutrition or disease, and lack of physical fitness, such as is seen in overfed horses receiving insufficient exercise, are other predisposing conditions. Superpurgation may also result from the non-observance of the necessary preparation of the patient prior to the administration of aloes (see p. 304). Oleaginous and saline aperients may also occasion superpurgation, especially if, during their action, the horse be unduly exerted, or if he be exposed to chill.

SYMPTOMS.—The onset is usually sudden, and may be marked by rigor. Violent purgation soon sets in, accompanied by excessive and audible borborygmi and marked thirst. There are signs of acute abdominal discomfort, and even colicky pains; the pulse is weak, and the spirits are greatly depressed. If relief be not obtained, the pulse becomes markedly weak and thready, the temperature falls; there is evidence of extreme exhaustion, followed by collapse terminating in death, which may result within a few hours. Acute laminitis may occur as a sequel.

TREATMENT.—The animal should be placed in a comfortable loose-box, and should be warmly clothed. Chlorodyne in doses of 1 to 2 ounces may be given with prepared chalk in flour and starch gruel. Should this fail to control the purgation, and especially if constitutional disturbance supervene, resort should be had to the administration of full doses of tincture of opium, which exercises a remarkable sedative effect upon the violent peristaltic movements. Should there be marked exhaustion, 10 to 12 ounces of brandy may be given. The thirst may be assuaged by allowing the animal to drink small quantities of boiled milk or flour gruel. If necessary, the opium may be repeated, since it is imperative that the arrest of purgation be ensured.

While it is necessary to ensure the arrest of the violent peristalsis, the excessive use of powerful astringents is undesirable, since they may, in turn, induce severe constipation.

Convalescence usually extends over a period of seven to ten days, during which close attention must be directed to the patient's general management.

Intestinal Catarrh in Foals.—This is probably one of the commonest affections in foals of from one to two weeks of age. The attack varies in its severity, but mild cases usually yield to simple treatment.

ETIOLOGY.—The separation of the working dam from the foal for prolonged periods; this results in deleterious changes in the composition of the milk, while the fasting foal is required to ingest large quantities of milk at irregular intervals. Febrile affections, œstrum, excitement or over-exertion of the mare, especially during the early period of lactation, are also associated with intestinal catarrh in the foal. Improper feeding of the dam, leading to digestive disturbance, especially that which results from permitting her to feed on lush pasturage, is another well-recognized factor.

SYMPTOMS.—The condition is marked by a persistent diarrhoea. The fæces are semi-fluid, light in colour, and highly offensive. There may be some elevation of temperature, the appetite is capricious, and weakness becomes rapidly pronounced and is progressive.

TREATMENT.—The mare and foal should be placed in a comfortable, sheltered enclosure. A dose of castor-oil combined with chlorodyne may be given, followed, if necessary, by intestinal antiseptics and astringents—salol, the compound tincture of camphor and opium, full doses of bismuth combined with alkalies, small repeated doses of brandy in milk, etc. This treatment is intended only to check the diarrhoea, since the use of powerful astringents may induce obstinate constipation. When the condition depends upon faults in the management and feeding of the mare, these should be corrected.

The working dam should not be separated from her foal for periods of more than three hours. She should not be over-exerted, and on return from work should be rested before her foal is returned to her.

Great care must be observed in the administration of draughts to foals, as the risk of inhalation is a very real one. When it is necessary to rear an orphan foal on cow's milk, this should be previously adjusted by the addition of proper amounts of water and sugar: 3 parts of fresh milk are diluted with 1 part of water, and to every pint of this mixture, $2\frac{1}{2}$ teaspoonfuls of sugar and $\frac{1}{4}$ teaspoonful of potassium bicarbonate are added. In these cases it is preferable to use the milk of one cow, which can be given a generous diet in which linseed-cake should be well represented. The addition to the milk of a vitamin A concentrate may prove of benefit.

Constipation.—**ETIOLOGY.**—Constipation may result from muscular atony of the bowel and/or from deficient intestinal secretion. It is associated with dietetic error—e.g., the feeding of excessive amounts of dry fodder, an insufficient supply of water—and also with lack of exercise. Constipation may occur in

dyspepsia, especially when this is complicated with biliary disorder; it is also a common concomitant of fever. It is more usually encountered in aged than in young animals.

TREATMENT.—Since constipation is to be regarded as a symptom, it must be treated as such, and remedial efforts must be directed to the conditions upon which it depends. The food should be of a laxative nature; a proper supply of water should be provided, and regular exercise ensured. The immediate symptoms may be relieved by a gentle aperient or by enemata. This may be followed by a course of nervine tonics and bitters, or a small quantity of linseed-oil may be given daily in the food.

B.—Cattle.

Intestinal disorders in cattle are of comparatively minor importance. Although cessation of intestinal peristalsis is a common symptom, it is usually associated with disorders of the stomachs (*q.v.*). Spasmodic colic, flatulent colic, and impaction of the colon are of very rare occurrence. Their treatment is similar to that indicated for these conditions in the horse.

Intestinal Catarrh.—ENTERITIS.

ETIOLOGY.—Acute catarrhal enteritis occurs as a complication of certain specific conditions, such as anthrax and malignant catarrhal fever. It also results from heavy infestations of helminth parasites. Apart from these conditions, catarrhal inflammation of the bowels is commonly associated with chill, in which case its development is due to bacterial invasion of the intestinal mucosa.

SYMPTOMS.—The symptoms in the early stages closely resemble those of acute abomasitis (*q.v.*), with which catarrhal enteritis is very commonly associated; but in enteritis, diarrhoea is very profuse, and is accompanied by considerable tenesmus. Dysenteric symptoms may also be in evidence. In severe cases, weakness and emaciation are rapidly progressive.

Intestinal catarrh of a subacute type may run a course of one to two weeks. Constitutional disturbance is comparatively slight, but the condition is characterized by a persistent diarrhoea. Such cases must be distinguished from Johnie's disease, a specific chronic enteritis (see Johnie, p. 383).

TREATMENT.—The treatment is largely symptomatic. The patient should be confined in a warm, sheltered enclosure, and clothed if necessary.

Medicinal treatment may commence with a full dose of castor-oil, followed by intestinal antiseptics and astringents—chlorodyne, the camphorated tincture of opium, kaolin, chalk, bismuth,

liquor formaldehydi. The thirst may be assuaged by demulcent and astringent drinks—flour or starch gruels, barley-water, etc.—offered in small quantities. In gastro-enteritis, the treatment is that indicated on p. 396.

Dysentery.—As has been indicated, dysentery of a non-specific character may complicate cases of acute enteritis.

TREATMENT is on similar lines.

Intestinal Catarrh in Calves—ETIOLOGY.—When occurring in calves of less than two weeks of age, the condition may represent 'white scour,' a serious epizootic enteritis with which a number of specific bacteria have been incriminated. Apart from this condition, intestinal catarrh usually occurs as the result of dietetic error. In suckling calves, the affection may be traced to disease of the dam, particularly mastitis. In the case of hand-reared calves, the use of unsuitable or improperly prepared milk substitutes, lack of cleanliness of utensils, etc., are common causal factors. The condition may also complicate general catarrhal infections, such as are associated with chill and exposure. An insufficient supply of vitamin A is now known to increase susceptibility to infection.

TREATMENT.—The animal should be placed in warm, comfortable conditions, and dietetic faults should at once be corrected. Medicinal treatment is similar to that for intestinal catarrh in foals (see p. 412).

C.—The Dog.

Acute Catarrhal Enteritis—ACUTE INTESTINAL CATARRH.—This condition may arise as a complication of specific catarrhal infections—e.g., distemper; in young dogs it may be due to heavy ascaris infestation, while when in association with gastritis it may result from the introduction of chemical irritants to the stomach and bowels. In many cases the intestinal catarrh occurs as a complication of gastritis, but the cause is frequently quite obscure.

SYMPTOMS.—The symptoms are to a considerable degree dependent upon the circumstances of the case, but, apart from those associated with distemper, ascaridiasis, irritant poisoning, or catarrhal gastritis (*q.v.*), the prominent symptom is that of diarrhoea, which is usually profuse and accompanied by considerable tenesmus. There is marked depression of spirits; the abdominal wall is contracted, and may be painful on pressure; the coat is dishevelled, and the skin loses its normal soft, pliant character, becoming dry and harsh to the feel. The conjunctiva may be icteric, and the temperature is raised (104° to 106° F.). Weakness and emaciation are rapidly progressive, and in the later stages prostration supervenes, with fall in body temperature,

and finally collapse. In acute cases death may occur within twenty-four hours.

TREATMENT.—The treatment is largely symptomatic, and good nursing is of prime importance. The animal should be kept in clean, warm, comfortable surroundings.

Medicinal treatment consists in the administration of a simple oleaginous laxative, followed by intestinal astringents and antiseptics—bismuth in large doses, chalk, chlorodyne, tincture of opium and camphor, emetine, salol, etc. If purgation be severe, more powerful astringents—the tannic acid series, sulphuric acid, hæmatoxylin, etc.—may be indicated. The hypodermic injection of morphine occasionally affords rapid relief.

It is necessary to maintain the patient's strength. Solid food must be withheld, but, since there is considerable thirst, liquid nutrients of a demulcent nature—boiled milk and milk foods containing egg albumin, well-made flour gruels, etc.—may be taken voluntarily; these, however, should not be allowed in large quantities at one time. Upon recovery from the acute symptoms, milk foods, steamed white fish, varied with meat extracts should be continued during the period of convalescence.

Hæmorrhagic Gastro-Enteritis—CANINE TYPHUS, 'STÜTTGART DISEASE.'—This condition usually occurs sporadically, but is also encountered as an enzootic, widely distributed in incidence, and with little or no apparent connection between individual cases.

ETIOLOGY.—The etiology is unknown, but see Vitamin B₂, p. 359.

SYMPTOMS.—The syndrome includes persistent vomiting and diarrhœa, hæmorrhagic in type; rapid progressive weakness and prostration, associated with a distinct diathesis to necrotic stomatitis.

The treatment is entirely symptomatic, but gastric irrigation with antiseptics and gastric sedatives (boric acid, 1 or 2 per cent.; potassium permanganate, 1 in 2,500; or normal saline solution) is specially advised.

The administration of nicotinic acid appears to have given promising results in the treatment of this disease.

Subacute Intestinal Catarrh may occur as a sequel to the acute form, in which case a similar line of treatment is followed. It may also be associated with passive congestion of the intestines resulting from cardiac or hepatic disorder. In a large number of cases it is due to ascaridiasis. In these conditions treatment is to be directed to the removal of the cause.

Ascaridiasis.—As has been indicated, ascaris infection may occasion an intestinal catarrh of a subacute type. Puppies and young dogs are most commonly affected. Apart from the symptoms of subacute intestinal catarrh growth is retarded; there is

considerable distension of the abdomen, capricious appetite, whimpering, restlessness; there may also occur attacks of violent epileptiform convulsions, and even hysterical mania.

The treatment consists in the removal of the worms by suitable anthelmintics—santonin and chenopodium. Santonin is not irritant to the mucosa of the gut, and is particularly indicated when symptoms of intestinal catarrh are present.

Constipation—ETIOLOGY.—Intestinal atony is commonly associated with old age and with lack of sufficient exercise. Other factors include the use of dry, constipating foods; the ingestion of quantities of bones, leading to the formation of impacted masses composed of bony spicules in the colon and rectum; painful defæcation due to hæmorrhoids, or inflammatory conditions of the anal glands. Constipation is present in many febrile affections, and is of common occurrence in dyspepsia.

SYMPTOMS.—Frequent tenesmus and painful ineffectual attempts at defæcation. If the condition be not relieved the animal becomes dull and listless; catarrhal stomatitis is present; there is also loss of appetite and occasional vomiting. Rectal exploration reveals the presence of hard fæcal masses in the rectum; these can also be determined by abdominal palpation.

TREATMENT.—The rectum should be evacuated by means of enemata of soap and warm water. Thereafter an aperient dose of liquid paraffin is given, followed by a course of cascara sagrada.

When rectal impaction is present, this must be broken down by the finger, aided, if necessary, by a blunt instrument, such as a rigid probe. When the impaction consists of a hard mass of bony spicules, considerable care and time may be required for its disintegration and removal.

When constipation depends upon errors in feeding and management, these should be corrected, and especially in cases which are subject to rectal impaction, bones should be withheld from the diet.

When constipation is associated with painful conditions of the anus, the anal glands should be evacuated by pressure and local applications—warm antiseptic compresses, astringent sedative dressings, etc.—applied.

The failure of medicinal treatment in the relief of the immediate symptoms calls for the consideration of surgical measures.

DISEASES OF THE LIVER.

Hepatic diseases offer a wide field of interest to the Veterinary Pathologist, but to the Clinician they present only limited opportunity.

Symptoms of hepatic disorder are few and indefinite, but in many cases the clinical evidence is such that the probable presence of liver dysfunction can be deduced.

The principal functions of the liver include:

(1) Regulation of Carbohydrate Metabolism: By removing excess glucose from the blood, storing it in the form of glycogen, and reconverting it into glucose as occasion requires.

(2) Regulation of Protein Metabolism: By the hydrolysis of any unwanted amino-acids which may be circulating in the blood, and by synthesizing urea from the ammonium salts formed in this process.

(3) Regulation of Fat Metabolism: The fats stored in the adipose depôts are transferred to the liver, where the fatty acids are desaturated, and thus the oxidation to carbon dioxide and water is facilitated.

(4) Pigmentary Functions: The decomposition of hæmoglobin and its subsequent conversion into bilirubin is accomplished in the liver. The bilirubin, along with the bile acids and cholesterol, are subsequently excreted in the bile.

(5) Detoxicating Functions: The liver, by destroying toxins, whether these be produced during tissue metabolism or absorbed from the gut, has an important detoxicating action. It is also capable of removing from the blood poisonous substances such as the heavy metals which cannot be rapidly destroyed.

Icterus—JAUNDICE.—Icterus, or jaundice, is a condition characterized by yellow discoloration of the conjunctiva and the non-pigmented skin, due to an excess of bile-pigment in the blood.

ETIOLOGY.—Jaundice occurs in three forms:

(1) *Hæmolytic Jaundice*.—This form of jaundice results from the rapid destruction of red blood-corpuscles with consequent liberation of hæmoglobin, and its subsequent conversion into bilirubin. It occurs in piroplasmoses—e.g., protozoal hæmoglobinuria ('red-water') in cattle.

(2) *Toxic Hepatic Jaundice*.—This form is associated with damage to the hepatic parenchyma whereby the liver is unable to take up from the blood a normal quantity of bilirubin. As a result, the pigment in the portal capillaries is not transferred into the bile-capillaries, but passes directly into the hepatic veins, and accumulates in the blood.

Examples of toxic hepatic jaundice are seen in chloroform poisoning, in poisoning with arsenic and phosphorus, in spirochætosis ictero-hæmorrhagica in dogs ('yellows'), and in pneumonia. It may also occur after large doses of chloral hydrate, male fern, santonin, and acetanilide.

(3) *Obstructive Hepatic Jaundice* results from obstruction of the

bile-ducts by calculi, but is most commonly associated with acute catarrhal conditions—*e.g.*, influenza and distemper. It is particularly well marked in dogs, the subjects of chronic intussusception. The obstruction in these cases is due to occlusion of the ducts by the catarrhal swelling of their mucosa (catarrhal jaundice), the catarrh extending by continuity from the bowel.

SYMPTOMS.—The animal is dull, listless, and easily fatigued, the appetite is in abeyance, the pulse slow, and the temperature subnormal. Biliuria is a concomitant of obstructive jaundice (see Tests, p. 37), but the presence of urobilin may be transient even in severe cases. Bile-pigment usually appears in the urine some hours before the occurrence of icteric discoloration of the conjunctiva and skin. In obstructive jaundice, when the obstruction is complete, no bile reaches the intestine, and the fæces become pale in colour and, especially in the dog, may contain an abnormal proportion of fat. The absence of bile from the small intestine leads to imperfect digestion. Bile-pigments may also be present in the sweat and milk, but the saliva, intestinal mucus, and cerebro-spinal fluid are free from bilirubin.

The later stages of jaundice are characterized by extreme prostration, lethargy, and finally coma. In the dog they may be complicated by nervous phenomena of a vertiginous or convulsive character.

TREATMENT.—The treatment is indicated by the primary condition upon which the icterus depends.

PERITONITIS.

Peritonitis in the domestic animals, when not due to chronic infective processes—*e.g.*, tuberculosis—is almost invariably traumatic or post-operative in origin, and depends in all cases upon bacterial infection of the peritoneum.

TREATMENT.—The treatment, when that is practicable, is surgical in nature, and the reader is referred to the standard textbooks on Veterinary Surgery.

ASCITES.

Ascites is an accumulation of fluid in the peritoneal cavity. The fluid is serous, non-inflammatory, clear and sterile, and thus differs from an inflammatory peritoneal exudate.

ETIOLOGY.—Ascites may occur as the result of a rise in pressure in the portal area. Thus, it may arise from the presence of hepatic neoplasms, and is also seen in tuberculosis of the liver in cattle and dogs, and in distomiasis in sheep. In these conditions the intralobular branches of the portal vein are pressed upon

and occluded. It is postulated, however, that mechanical pressure upon the portal venous system cannot be the sole cause of the ascites, since the amount of ascitic fluid in a given case may bear no relation to the degree of portal obstruction, and since ascites may be absent when the portal pressure is relatively very high. It is therefore suggested that ascites, when associated with hepatic disease, is in part due to the action of toxins normally destroyed by the liver, which exert a lymphagogue action and increase transudation into the peritoneal cavity.

In general dropsy due to cardiac disorder, with resultant venous congestion, ascites is usually a marked feature. The condition is also associated with acute and chronic parenchymatous nephritis, and with cachectic anæmia, but the nature of the pathological relationships in these conditions is not clearly determined.

In dogs, ascites is commonly associated with tubercular peritonitis. Occasionally ascites in the dog disappears rapidly and completely. The pathology of such cases is obscure, since the condition appears to be independent of organic change.

SYMPTOMS.—Distension of the abdomen, which increases in a downward direction. If intermittent pressure be exerted upon one side of the abdominal wall, undulations can be felt by the flat hand placed on the other side (transmitted thrill). On percussion, complete dulness is elicited over the lower part of the abdomen, and the dulness extends up to a definite line, which can be altered by raising or lowering the fore-quarters. On auscultation, the intestinal murmurs are faint or imperceptible.

The affected animal is dull, the appetite is in abeyance, and there may be considerable dyspnoea on exertion, because of the pressure upon the diaphragm.

Dogs commonly assume an almost perpendicular, squatting position, with the apparent object of relieving the increased intrathoracic pressure.

TREATMENT.—The acute symptoms may be relieved immediately by paracentesis (see p. 472). In order to reduce the volume of transudate, diuretics should be employed, and when the ascites is dependent upon cardiac failure, digitalis, strophanthus, or squill combined with caffeine, theobromine and sodium salicylate are specially indicated. Further treatment depends upon the nature of the primary condition. Not infrequently treatment must necessarily be only palliative.

THE URINARY ORGANS.

A.—The Horse.

Active Congestion of the Kidneys—ETIOLOGY.—Active congestion of the kidneys occurs most commonly as the result of the ingestion of irritant substances—*e.g.*, mouldy fodder. It also results from the administration of irritant diuretics. Active congestion represents the early stage in acute nephritis, but in many cases it resolves before actual inflammation develops.

SYMPTOMS.—Little constitutional disturbance may be noted, but the animal shows signs of early fatigue if put to work. Marked polyuria is present. The urine is pale in colour, and of low specific gravity; the gait may be stiff, and tenderness may be evinced on pressure over the region of the kidneys. Thirst is excessive. When the condition is of dietetic origin, several or all of the horses in the stable are affected simultaneously.

TREATMENT.—The horse should be completely rested, and, if necessary, warmly clothed. The cause should if possible be determined and corrected. A complete change of fodder, even when this appears of good quality, is commonly followed by the rapid disappearance of the symptoms.

Despite the severe thirst, the attendant commonly withholds water in the mistaken belief that such practice is beneficial, in that it reduces the excessive urination. The polyuria is, however, a protective response on the part of the tissues, which has as its object the flushing of the irritated kidney. Demulcent drinks, such as barley water, should therefore be freely allowed. In severe cases hot compresses applied to the lumbar region afford some measure of relief.

Passive Congestion of the Kidneys—ETIOLOGY.—This condition is rarely encountered in the horse. It is usually associated with failure of compensation in organic disease of the heart.

SYMPTOMS.—The general symptoms depend upon the nature of the primary disease. The urine is diminished in volume, and the specific gravity is raised. It contains an excess of urates, and a variable amount of albumin.

TREATMENT, when that is practicable, is directed towards the primary condition upon which the passive congestion depends.

Nephritis—INFLAMMATION OF THE KIDNEYS.—In clinical veterinary practice the more commonly encountered forms of nephritis are as follows:

- (1) *Acute and Subacute Parenchymatous* (glomerulo-tubular).
- (2) *Chronic Parenchymatous*.
- (3) *Advanced Chronic Parenchymatous* (secondarily contracted kidney).
- (4) *Chronic Interstitial*.

Suppurative nephritis and pyelitis are not here discussed.

Acute and Subacute Parenchymatous Nephritis—ETIOLOGY.—The causal factors may be those of active renal congestion (*q.v.*), since this condition represents the first stage of acute nephritis. Acute nephritis may occur as a complication of acute specific fevers and streptococcal infections, in which cases it results from the absorption of bacterial products, or, in the case of suppurative nephritis, of the organisms themselves. Nephritis may be traumatic in origin, resulting from contusions in the region of the kidneys. The significance of chill in the production of the disease is doubtful.

SYMPTOMS.—In the early stages, if the onset be acute, the symptoms resemble those of active renal congestion, but the urine soon becomes diminished in volume, is heavily loaded with albumin, and may be smoky, or dark in colour, if it contain blood.

Microscopic examination of the urine reveals the presence of epithelial cells and tube casts. Œdematous swellings, especially of the limbs and dependent parts, are in evidence. The gait is straddling, and pressure over the region of the kidneys may induce pain. The temperature is irregular, but is usually raised (102° to 103° F.). In some cases total suppression of urine may occur with extensive dropsical effusions, general aggravation of the symptoms, and the development of uræmia, with which is associated severe digestive disorder, and in its acute form epileptiform convulsions and coma terminating in death. A urinous odour of the breath is commonly, but not invariably, present.

TREATMENT.—The patient should be placed in a comfortable box and warmly clothed. The food should be light, as it is important to avoid overloading the inflamed kidney with nitrogenous matter. For this reason oats should be eliminated from the diet, which may consist of hay in small quantities, roots, and mashes. In order to rest the kidneys, the elimination of effete products may be increased through other channels, particularly the bowels. For this reason an oleaginous purgative is indicated. Resinous and saline aperients should, as a rule, be avoided, as they may be partly excreted through the kidney, and so induce a diuretic action. While sweating represents another means whereby effete products can be eliminated, diaphoresis cannot be

readily induced in the horse, although perspiration may be promoted by warm clothing.

It is doubtful whether any therapeutic benefit can result from the administration of diuretics during the phase when the urine is markedly reduced in amount; when, however, the urine begins to increase in quantity, mild diuretics, such as the citrate or acetate of potassium, may be administered, but irritant diuretics are contra-indicated. After the symptoms have decreased in intensity, and especially if the arterial tension be low and the cardiac impulse weak, digitalis in small doses may be prescribed as a cardiac stimulant. While water in moderate allowance aids in the flushing of the kidneys, large quantities should be avoided.

The development of uræmia represents a very serious complication. Indeed, little can be done other than controlling the convulsive seizures by means of narcotics—*e.g.*, chloral hydrate enemata.

Chronic Nephritis.—Chronic parenchymatous and chronic interstitial nephritis are recognized clinically, but their differentiation may present considerable difficulty. The incidence of chronic nephritis in the horse is remarkably low.

PARENCHYMATOUS TYPE.—This usually occurs as a continuation of, or as a sequel to, the acute type.

SYMPTOMS.—The symptoms are indeterminate: a reduced capacity for work, gradual loss in physical condition, capricious appetite and cedematous swellings of the limbs, possibly extending to the lower chest and abdomen.

The urine is scanty, contains albumin, considerable quantities of epithelial cells and casts, and occasionally blood. There may be little disturbance of temperature or pulse, but the weakness and reduction in physical condition, especially in horses which continue to be worked, are progressive. The condition may be associated with cardiac hypertrophy.

In the advanced stages of chronic parenchymatous nephritis (secondarily contracted kidney) the volume of urine is increased, and the albumin is markedly reduced in amount, although tube casts continue to be passed.

A latent renal affection may be in existence for some time without its manifesting observable symptoms of illness, but if the animal be exposed to chill, excessive fatigue, or if it be allowed excessive amounts of nitrogenous food, symptoms of nephritis may develop. The course is progressive; death may occur from uræmia, or from complications such as pleurisy, pneumonia, and pericarditis.

INTERSTITIAL TYPE.—The onset is insidious. The symptoms in general are similar to those of the chronic parenchymatous type.

TREATMENT.—The treatment of chronic nephritis can at most be palliative. In the case of working horses, the destruction of the animal may be dictated by humanitarian and economic considerations.

The student must clearly realize that the presence of albumin in the urine does not necessarily indicate nephritis. In order to assess the significance of albuminuria, repeated urine analyses must be made at intervals, and the clinical picture carefully studied as a whole.

B.—Cattle.

Clinical manifestations of nephritis in cattle are of rare occurrence. The principles of treatment are similar to those indicated for the horse, but for economic reasons treatment is seldom practicable.

C.—The Dog.

Acute Nephritis.—Acute inflammation of the kidneys is relatively common in both the adult dog and in puppies.

ETIOLOGY.—The causal factors are similar to those concerned in acute nephritis in the horse.

SYMPTOMS.—The onset of the attack is frequently sudden, but there may be a period of indefinite malaise before acute illness is evident. The appetite is at first capricious, but very soon all food is refused. Walking is performed stiffly and the back is usually arched; pronounced tenderness over the region of the kidneys may be determined by palpation. Repeated attacks of vomiting commonly occur and may be of a severe character.

There is usually a slight initial increase in the amount of urine, but this frequently passes unnoticed; the urine soon becomes reduced in volume, and because of its high concentration and its markedly acid reaction, its passage causes considerable discomfort and reflexly induces frequent attempts at micturition.

As has been indicated, the urine is acid in reaction and its specific gravity is increased. It contains albumin, and blood is usually also present; this may occur only in sufficient amount to render the urine 'smoky' in appearance, or the amount of blood may be such that a reddish-brown flocculent precipitate is formed immediately the urine is passed.

Microscopically deposits are evident; these in the earlier stages include blood casts and epithelial casts; later granular and hyaline casts may be found; the presence of micro-organisms is rare.

The condition is invariably associated with some degree of uræmia. Some cases make a complete recovery, others may

become subacute and finally chronic in character. In severe cases uræmia may result as a terminal toxic phase.

The syndrome of uræmia constitutes that of a grave toxæmia, characterized by great prostration and severe vomiting; a urinous odour is frequently exhaled from the breath and skin.

Convulsions may precede a period of coma which terminates in death.

TREATMENT.—The general principles of treatment of acute nephritis in the dog are similar to those described for the horse (see p. 421). Meat extracts and other highly nitrogenous nutriments should be entirely withheld. Iced water to which 5 per cent. glucose may be added should be repeatedly allowed in small quantities. It may be proper to administer gastric sedatives in order to control the vomiting. In uræmia, treatment is entirely symptomatic and is almost invariably useless.

Chronic Interstitial Nephritis—**ETIOLOGY.**—The cause is obscure, but it is generally attributed to the absorption of toxins of indeterminate nature.

SYMPTOMS.—While chronic interstitial nephritis usually occurs in older dogs, it may also be encountered in relatively young animals.

The early stages are frequently manifested by irregular attacks of vomiting which occur throughout a period varying from a few weeks to one or two years. Indefinite symptoms of dulness and progressive loss of physical condition are associated with pronounced thirst and marked polyuria. A catarrhal conjunctivitis is frequently present in advanced cases, and examination of the eyes may show opacity of the lens and in some cases sub-retinal hæmorrhages. The skin may be dry, scaly, and smell strongly of urine. Cardiac hypertrophy with high blood pressure and a strong bounding pulse are constant features of the disease. The urine is clear and limpid; the specific gravity is low; albumin is present in small amounts. Deposits are present and contain hyaline and granular casts, but there are no renal epithelial cells.

TREATMENT.—The course may or may not be protracted, but treatment can be only symptomatic and palliative.

CYSTITIS.

Cystitis—**INFLAMMATION OF THE BLADDER.**—This condition varies in severity from a simple catarrh of the vesical mucosa to an intense inflammation with deep-seated lesions of the viscus.

A.—The Horse.

ETIOLOGY.—The etiological factors include irritant substances excreted in the urine—*e.g.* cantharidin, oil of turpentine; bacterial infection of the bladder, such as may occur in suppurative nephritis, pyelitis and septic metritis, or may result from the use of an infected catheter; injuries due to careless catheterization; chronic irritation arising from the presence of vesical calculi, etc. Cystitis may also occur as a concomitant to specific fevers. In cystitis the bladder is not completely emptied of urine; there remains a residuum which tends to undergo rapid ammoniacal decomposition. The irritation is thus continued, and so a vicious cycle is established.

SYMPTOMS.—Frequent and painful attempts at micturition. The urine is passed in small quantities, often in intermittent jets or dribbles (strangury), leading in the female to excoriation of the skin of the perineum and the thighs. Pain may be elicited on palpation of the bladder, which will be found almost empty, and defæcation may be accompanied by tenesmus.

The animal is restless, and signs of acute discomfort are in evidence. In the male, priapism may be frequent and sustained. Systemic symptoms may be slight or absent. In cases due to the presence of vesical calculus this may be determined on rectal examination. The urine is generally cloudy, thick and highly coloured, and contains small amounts of albumin and mucus. Occasionally portions of false membranes, purulent flocculi, or shreds of tissue are also present.

TREATMENT.—Complete rest must be ensured, and a non-stimulating diet should be ordered. Mucilaginous drinks—linseed tea, barley water, etc.—should be allowed *ad libitum*. Mild alkaline diuretics—potassium citrate, bicarbonate of soda with vesical sedatives, belladonna and hyoscyamus—may be given with the demulcents. Urinary antiseptics of a non-irritating nature—*e.g.*, hexamine—are also indicated.

In severe cases, irrigation of the bladder may be adopted. The bladder is first flushed out with a warm solution of sodium chloride ($\frac{1}{2}$ per cent.), about 300 c.c. being allowed to gravitate through a catheter attached by an indiarubber tube to a funnel. The fluid is then allowed to flow out by lowering the funnel, and the antiseptic—boric acid, protargol, chinosol—is then introduced and removed in the same manner.

B.—The Dog.

ETIOLOGY.—The causal factors are similar to those which obtain in the horse. Dogs which have been trained to retain their urine for prolonged periods may be the subjects of cystitis,

the retained urine undergoing ammoniacal decomposition, with consequent irritation of the vesical mucosa.

The affection is also commonly associated with prostatitis and vesical calculi.

SYMPTOMS.—The symptoms and principles of treatment are similar to those indicated for the horse.

Cystitis, associated with urethritis and deposition of sabulous material in the urethra, leading to urine retention, is commonly met with in the male cat. Treatment is surgical (see also p. 476).

Chronic Cystitis may occur as a sequel to an acute attack, but in many cases the onset is insidious.

The symptoms are similar to those of the acute type, but are much less severe, and the principles of treatment are those advised for acute cystitis.

CATARRHAL AFFECTIONS OF THE RESPIRATORY ORGANS.

A.—The Horse.

Acute Nasal Catarrh—CORYZA, RHINITIS.

ETIOLOGY.—Acute nasal catarrh occurs in a number of specific fevers—*e.g.*, influenza—but may arise as a primary condition. Chill and exposure are known to be important factors in the production of catarrh, but although their action is obscure, their effect appears to predispose the mucosa to bacterial invasion, which is the immediate cause of the catarrhal affection. The virulence of the infection is enhanced by passage through a susceptible animal, and thus the condition may rapidly become epizootic in a stud. Mechanical and chemical irritants—*e.g.*, dust and irritant vapours—are very rarely concerned in the production of nasal catarrh in the horse.

SYMPTOMS.—There is a typical catarrhal nasal discharge; at first serous, then, after a few days, muco-purulent in character, accompanied by a soft cough. There may, or may not, be some degree of malaise, with reduction in appetite, but there is usually no marked systemic disturbance.

In more severe cases febrile symptoms are present, the appetite is in abeyance, and there is evidence of constipation. Some degree of conjunctivitis is usually present, and extension of the catarrhal process to the larynx and pharynx results in laryngeal irritation and cough. The submaxillary lymphatic glands are usually enlarged.

The course is favourable, recovery resulting in four to ten days, unless the catarrhal process extend by continuity to involve the bronchi or lungs, or the submaxillary lymphatic glands become the locus of a septic adenitis.

TREATMENT (see p. 430).

Strangles is an acute infectious nasal catarrh principally affecting young horses, and frequently characterized by the development of septic adenitis affecting particularly the submaxillary lymphatic glands.

The etiology is unknown, but *Streptococcus equi* (Schütz) is found in constant association with the disease.

Occasionally the septic infection, by gaining entrance to the blood or lymph-streams, occasions a metastatic pyæmia.

TREATMENT (see p. 430).

Chronic Nasal Catarrh.—This usually occurs as a sequel to an acute attack. It is also associated with glanders and with certain surgical conditions involving the air sinuses, turbinated bones, etc. (see p. 432).

Acute Laryngitis—INFLAMMATION OF THE LARYNX.

ETIOLOGY.—Inflammation of the mucous membrane of the larynx is very frequently associated with pharyngitis, and usually arises as a complication of acute nasal catarrh. It may also occur during the course of specific catarrhal fevers, such as influenza. The affection varies in the degree of its intensity, and assumes a very serious character when the glottis and the epiglottis are involved in oedema with exudative thickening of the mucous and submucous coats (oedema glottidis).

SYMPTOMS.—The condition is manifested by a hard, dry paroxysmal cough, which may be painful and suppressed; later the cough becomes softer in character, and is accompanied by a muco-purulent nasal discharge. The coughing attacks are particularly evident during feeding and can be readily induced by manipulation of the laryngeal region. There may be some elevation of temperature, accompanied by other symptoms of fever. While in itself a simple affection, the acute catarrhal process may extend by continuity to the bronchi and lungs, while, as has been indicated, the sudden development of oedema glottidis, characterized by stertor and severe dyspnoea, represents a serious complication.

TREATMENT (see p. 432).

Chronic Laryngitis.—In chronic laryngitis systemic disturbance is absent, but the condition is characterized by a persistent cough. Neglected cases of chronic laryngitis are not uncommonly followed by 'whistling' or 'roaring.'

TREATMENT (see p. 432).

Acute Bronchitis.—ACUTE INFLAMMATION OF THE BRONCHI.

ETIOLOGY.—The causal factors of acute bronchitis are similar to those of acute nasal catarrh (see p. 427), which commonly precedes its development. It may also result from the inhalation of irritant medicinal agents administered in the form of draughts, but in such instances it is usually associated with bronchial pneumonia.

SYMPTOMS.—The severity of the symptoms depends largely upon the extent of the affection. When the catarrhal process is confined to the larger tubes, the symptoms are relatively mild in character; but when the smaller bronchi and bronchioles are also involved, the transition from bronchitis to pneumonia cannot be defined clinically.

When affecting the larger bronchi only, fever may be absent, but is usually present in variable degree. The pulse is frequent and soft in quality, and the respirations are accelerated. In the early stages there is a dry, harsh, persistent cough, which later becomes softer and looser upon the occurrence of exudation of bronchial mucus.

The symptoms may be associated with those of nasal catarrh and laryngitis.

No appreciable abnormality is revealed by percussion, but on auscultation, in the early stages, harsh, blowing bronchial sounds are heard over the lower region of the trachea and the upper border of the middle third of the chest. In the later stages the rhonchi are replaced by moist râles.

The symptoms of acute bronchitis, involving the smaller bronchioles, are similar to those of bronchial pneumonia (see p. 430).

TREATMENT (see p. 432).

Chronic Bronchitis—ETIOLOGY.—This condition usually occurs as a sequel to an acute attack, but it may develop insidiously, especially in aged, debilitated animals kept under insanitary conditions. Occasionally it is associated with cardiac hypertrophy and valvular insufficiency of the right heart. Chronic bronchitis is also commonly associated with pulmonary emphysema, of which it may be the primary cause.

SYMPTOMS.—Systemic symptoms are absent, but the condition is characterized by a persistent, harsh cough, which is often paroxysmal. Accelerated wheezing respirations and considerable respiratory distress may be induced by comparatively slight exertion. There is an intermittent, whitish, flocculent nasal discharge, especially evident after an attack of coughing. Because of the chronic bronchial obstruction, the condition may proceed to bronchiectasis and pulmonary emphysema, with which are associated the condition known as 'broken wind.' Auscultation may reveal sibilant or sonorous rhonchi or moist râles.

TREATMENT (see p. 432).

Pneumonia—INFLAMMATION OF THE LUNGS.—Clinically, pneumonia may be recognized as lobular or lobar according to the extent of the pulmonary involvement. Thus, in the lobular type there may be many widely diffuse patches of consolidation throughout the lungs, while in the lobar type, because of the confluence of numerous inflammatory lobules, one or more large areas of effusion or consolidation result. It will be seen, then, that the clinical classification of acute pneumonia is based mainly on the distribution of the inflammatory areas in the lung, and consequently upon the extent of the affection.

In both types the pathological process is that of catarrh extending by continuity from the bronchi to the bronchioles, and finally involving the alveoli, with a tendency to the occurrence of septic and necrotic foci in the consolidated areas.

ETIOLOGY.—The causes are those of acute bronchitis, by which catarrhal pneumonia is always preceded. Pneumonia frequently complicates specific infectious fevers—*e.g.*, influenza; it may develop as a primary epizootic, although, in many instances, it remains sporadic in its occurrence.

SYMPTOMS.—Although pneumonia commonly occurs as a distinct complication of bronchitis, in numerous instances the transition is rapid and indefinite. With the involvement of the smaller bronchioles the temperature rises, and there develop all the concomitant symptoms of fever: quickened pulse-rate, accelerated, even dyspnoeic, respirations, anorexia and constipation, scanty, high-coloured urine, etc. The conjunctiva is somewhat congested, and icteric (toxic hepatic jaundice, see p. 417). There is commonly a frequent but ineffective cough. In the earlier stages of lobular pneumonia no dulness is appreciable by percussion. In lobar pneumonia, extensive areas in which the vesicular murmur is feeble or absent may be determined on auscultation. The normal inspiratory vesicular murmur is commonly replaced by a harsh bronchial sound. In lobar pneumonia, tubular breathing may occasionally be heard throughout the areas of consolidation. Pneumonia is not infrequently complicated by some degree of pleurisy (*q.v.*).

The course is very variable; in fatal cases death may occur within a few days. Recovery is slow, the resolution being almost invariably by lysis, and convalescence may be protracted over a period of several weeks.

During resolution the febrile symptoms subside, the cough becomes easier, the general appearance of the animal is brighter, and the appetite improves, although it may remain capricious for a considerable time. On auscultating the lung during the period of resolution, moist crepitant râles are heard over the affected areas.

Treatment of Catarrhal Conditions of the Respiratory Tract.

Since all the foregoing conditions—coryza, laryngitis, bronchitis and bronchial pneumonia—are dependent upon a common pathological process—*i.e.*, catarrh—and since the progression of this process from nares to lung or, alternatively, the arrestment of this progression is dependent upon the virulence of the invading organisms and the powers of resistance of the animal

to the microbic invasion, it follows that the general principles governing the treatment of these conditions are common to all. The essentials of treatment are:

Rest.
Fresh air.
General comfort.

To apply this to practice, the animal is removed from the working stud, placed in an open box, or sheltered, dry, airy enclosure (see p. 44), given a comfortable bed of straw, a free supply of pure cold water, offered wholesome attractive food, and, if necessary, warmly clothed.

Drugs are of limited value in the treatment of respiratory catarrh in the horse (but see p. 363). Purgatives are entirely contra-indicated, as horses suffering from catarrhal affections are particularly susceptible to superpurgation. The bowels may be moved by laxative food, to which may be added small doses of saline febrifuges. Medicines should never be administered in the form of draughts; these readily induce coughing, and portions of the draught may be aspirated into the lung during the strong inhalation which precedes the cough.

The patient should, as far as practicable, be undisturbed. The repeated applications of therapeutic measures, such as medicated inhalations, frequently harass a sick horse; if so, they should be discontinued.

Since many cases of respiratory catarrh are infectious in character, strict isolation of the affected animals should, where possible, be observed.

SPECIAL INDICATIONS.

ACUTE NASAL CATARRH.—Inhalations of water vapour, medicated with eucalyptus, terebene, compound tincture of benzoin, etc. (see p. 102), allay the irritation of the nasal mucosa, and by stimulating glandular secretion assist in clearing the nasal passages.

STRANGLES.—The treatment is that indicated for catarrhal respiratory affections in general. The highly infectious nature of strangles requires that the patient be immediately segregated. It is important to hasten the maturation of the abscesses, and to obtain evacuation of their contents. With this object hot fomentations, followed by the application of a dry cotton-wool compress, may be employed.

Polyvalent antistreptococcic vaccines and sera (p. 369) have been employed in the preventive and curative treatment of

strangles. Such beneficial effects as they may exert are irregularly produced.

CHRONIC NASAL CATARRH.—When the nature of the case is uncertain, the occurrence of a chronic nasal discharge suggests the possibility of a glanders infection, and unless the clinical indications are such that glanders can be certainly eliminated, the mallein test should be applied (see p. 381). The repeated inhalation of water vapour containing volatile antiseptics may be tried, but efforts should be specially directed to effecting an improvement in the general health of the animal. With this object, tonics—iron, arsenic, malt, cod-liver oil—are commonly prescribed, but greater benefit usually results from putting the horse to pasture, if that be practicable.

ACUTE LARYNGITIS.—Medicated inhalations of water vapour are helpful, and benefit is usually afforded by the administration of simple sedative electuaries and the application of a stimulating liniment, or a sinapism, to the throat. When marked respiratory distress is manifested, tracheotomy should be performed, as the rapid development of oedema glottidis may result in death from asphyxia.

CHRONIC LARYNGITIS.—The principles of treatment are similar to those indicated for chronic nasal catarrh (*q.v.*).

ACUTE BRONCHITIS.—In the early stage, medicated inhalations of water vapour allay irritation of the bronchial mucosa, promote bronchial exudation and facilitate its discharge. Demulcent electuaries tend to relieve distressing cough. Expectorants are of doubtful value in equine bronchitis. A mild application of mustard to the chest is frequently of benefit, especially in the early stage. Vesicant applications are entirely contra-indicated; they possess no therapeutic value, and cause much distress to the patient.

CHRONIC BRONCHITIS.—As in the case of chronic rhinitis and chronic laryngitis, treatment should aim at improving the general health of the patient. Counter-irritation of the chest is not indicated.

PNEUMONIA.—When the case is obtained at an early stage, pneumonia usually responds to the adoption of the general principles of treatment outlined above. The application of mustard to the chest *in the early stages* is frequently of marked benefit, and the hypodermic injection of caffeine or strychnine may be indicated when the heart's action is laboured during the height of the attack, but the course of the disease could not until recently be appreciably affected by drugs. The application of sulphanilamide and sulphapyridine in the treatment of pneumonia is discussed on p. 363.

Our object should be that of nursing the patient's strength, and so ordering the conditions that the animal's natural powers of resistance to disease can exert themselves to the greatest advantage.

Intravenous Injections of formalin are advised in cases in which the following conditions obtain: When the pneumonia is bilateral, the patient debilitated, the pulse weak and quick, the case 'hanging fire,' and there is reason to fear the development of pulmonary gangrene. These indications may occur at about the seventh day of illness. The solution, which is prepared by diluting 2 drachms of formalin with 2 pints of warm saline (previously sterilized by boiling), is slowly injected into the jugular vein under conditions of strict asepsis.

Intratracheal Injections.—For the same purpose—*i.e.*, the prevention of septic or gangrenous changes in the lung—intratracheal injection of solutions of iodine and other antiseptics is advised by some authorities. The practice is both irrational and dangerous.

Vaccine Therapy.—The employment of autogenous vaccines and polyvalent stock vaccines and sera in the treatment of pneumonia has proved, on the whole, disappointing.

Bronchial Asthma—**SPASMODIC ASTHMA.**—This affection is not common in the horse. It is characterized by sudden intermittent attacks of dyspnoea of variable duration, the symptoms usually subsiding abruptly. Spasmodic asthma commonly terminates in 'broken wind,' while in this affection asthmatic attacks not infrequently occur at varying intervals.

ETIOLOGY.—The nature of spasmodic asthma is not clearly understood. It is recognized that certain individuals are subject to the disease, and that in many cases the occurrence of the attack can be associated with particular conditions of climate, and with the inhalation or ingestion of certain substances. It is generally believed that, at least in many instances, the asthmatic paroxysm is an anaphylactic reaction induced by the absorption of extraneous proteins to which the subject is hypersensitive; the resultant vagotonia causes spastic constriction of the bronchioles, with turgescence of their mucosa and increased secretion of bronchial mucus.

SYMPTOMS.—Sudden attacks of dyspnoea which tend to recur at indefinite periods. During the quiescent intervals no symptoms are observed. The dyspnoea may be severe, the neck is extended, and the nostrils dilated. Respiration is of the abdominal type, and is accompanied by loud wheezing sounds. A paroxysmal, short, suppressed cough occurs at intervals. A nasal discharge, frothy in character, or containing thick, tenacious

mucus, may be present. The duration of the attack is very variable, but usually continues over one or more days.

TREATMENT.—The horse should be completely rested and placed in comfortable airy surroundings. Considerable and sometimes immediate relief can be afforded by the hypodermic injection of atropine, hyoscyamine or adrenaline, followed by repeated doses of the tincture of stramonium in the drinking water. These drugs act by causing relaxation of the bronchial muscles. Such relaxation is effected either by depression of the vagus (atropine, hyoscyamine, stramonium), or by sympathetic stimulation (adrenaline). The inhalation of amyl nitrite, which elicits direct relaxation of the unstriated muscle of the bronchi, also rapidly relieves the spasm.

The conditions under which particular cases occur should, if possible, be determined and avoided. The employment of drugs which induce vagotonicity—physostigmine, pilocarpine and arecoline—is contra-indicated in asthmatic subjects.

Active Pulmonary Congestion—ACTIVE CONGESTION OF THE LUNGS.

ETIOLOGY.—This condition precedes the development of pneumonia (*q.v.*). In many cases, however, the pulmonary congestion resolves before actual organic changes occur.

SYMPTOMS.—Some degree of fever is usually present, the pulse is full and soft, the respirations are hurried and dyspnoea may be severe. Percussion may reveal no abnormality, but, on auscultation, the vesicular murmur is subdued, and may be masked by a harsh sound of bronchial origin.

TREATMENT is similar to that indicated for pneumonia.

Passive Pulmonary Congestion is commonly met with in the horse, when the animal, not being in fit condition, is subjected to severe exertion. This not infrequently occurs in the hunting field. Under such conditions respiratory distress is manifested, and phenomena, due to engorgement of the pulmonary vessels and over-distension of the right heart, are observed.

SYMPTOMS.—A tendency to hang heavily on the bit, followed by a sprawling action in progression. If the animal be not quickly pulled up he stops voluntarily, or may fall and succumb to asphyxia (resulting from the pulmonary engorgement), or to syncope (from over-distension of the right heart).

In other cases there are observed laboured breathing, with marked heaving of the flanks; the fore-legs are abducted, the head extended, and the nostrils dilated. The visible mucous membranes are injected and somewhat cyanotic; there is marked coldness of the extremities, with sweating, general muscular tremors, tumultuous cardiac action, a small, weak, rapid and indistinct

pulse, and occasionally a frothy nasal discharge which may be slightly hæmorrhagic. In the less severe cases, provided rational treatment be adopted, recovery may ensue in one to two days. Pneumonia may develop as a sequel to the attack.

TREATMENT.—If the case occur in the hunting field, the saddle should be removed, the bit unbuckled, and the horse's head turned towards the breeze. The cutaneous circulation should be stimulated by briskly rubbing the surface of the body, and applying clothing and woollen bandages if these be available.

In from half an hour to two or three hours the urgent symptoms pass off, and the horse then can be slowly walked to the nearest available stable. The case should be carefully observed for the appearance of symptoms suggestive of the onset of pneumonia. The early application of mustard paste to the thoracic walls is beneficial, and if the cardiac action be weak a hypodermic injection of strychnine or caffeine is indicated. In very severe cases venesection and the removal of three or four quarts of blood is a rational procedure. The horse should not be returned to work until a satisfactory degree of physical fitness is obtained.

Chronic Alveolar Emphysema of the Lungs ('Broken Wind').—The condition known as broken wind commonly depends upon permanent dilatation and rupture of the pulmonary alveoli, which may be accompanied by atrophy of the interalveolar and interinfundibular septa, and of their contained bloodvessels.

ETIOLOGY.—Alveolar emphysema is a secondary affection depending, in the great majority of cases, upon the violent but suppressed expiratory efforts associated with chronic cough. Thus, the condition is frequently related to chronic bronchitis.

Little is known of the etiological factors concerned in the pulmonary emphysema met with in aged, obese animals leading an idle life. In such cases the development of the affection is insidious, and may represent the atrophic form of the disease, in which, because of atrophy of the alveolar walls, coalescence of adjacent alveoli results.

SYMPTOMS.—The symptoms usually appear insidiously. An obstinate cough is observed, and marked acceleration of the respiratory movements occurs when the animal is subjected to even moderate exertion. These phenomena gradually become accentuated until dyspnoea—even while the animal is at rest—and the characteristic broken-winded cough become prominent symptoms.

The respiratory movements are peculiar. Inspiration is short and abrupt; expiration is prolonged and laboured, and the movement is composed of two distinct efforts, interrupted by a short but appreciable pause.

Increased resonance can be elicited upon percussion of the chest wall, particularly over the inferior margins of the lung. Later the resonance may extend over the entire pulmonary area, while the area of cardiac dullness may be markedly constricted. On auscultation, sibilant or sonorous rhonchi are present, and crepitant râles may also be heard. The cough in the early stages is paroxysmal and dry in character, and is heard especially when the horse first leaves the stable. Later it becomes feeble, abortive, shallow and single, but when the animal is exerted, or if the larynx be compressed by the fingers, a series of shallow coughs is provoked.

In advanced cases, as has been indicated, dyspnoea and irregular respiration are manifested during repose. The nostrils are dilated, and the alternate rising and falling of the flanks is accompanied by a similar action of the muscles of the croup, and by an alternate protrusion and retraction of the anus. Cardiac palpitation may be observed upon exertion, and dilatation of the right heart, accompanied by cyanosis and œdematous swellings of the dependent parts, may complicate the latest stages. A flatulent condition of the intestines is frequently present, and the abdomen becomes enlarged and pendulous. Exacerbation of the symptoms is observed when the horse is fed upon large quantities of dry, indigestible fodder, and during intercurrent attacks of bronchial catarrh.

TREATMENT.—The disease is incurable, and only palliative measures can be adopted. These include attention to hygienic and dietetic details. Hay should be given in limited amounts, and the animal should be fed at least two hours prior to his being worked. Only slow work is possible. A number of drugs—arsenic, strychnine, and veratrine—are believed to be beneficial in alleviating the symptoms, but their value is very doubtful. Occasional doses of linseed-oil, or saline laxatives, given in the food, regulate the action of the bowels, and are thus beneficial. The early treatment of persistent cough constitutes an important preventive measure.

Pleurisy—PLEURITIS.—Pleurisy is an inflammation of the visceral pleura or its parietal reflexions. The clinical classification of acute pleurisy recognizes three types, but these merely represent stages in the response of the tissues to the causal factor.

(1) *Fibrinous or Plastic Pleurisy*, also known as Dry and Adhesive Pleurisy, in which there is no appreciable effusion.

(2) *Sero-Fibrinous Pleurisy*, Pleurisy with effusion, in which a serous or sero-fibrinous effusion occurs. It represents the later stage of fibrinous pleurisy.

(3) *Empyema or Purulent Pleurisy*, in which the pleuritic exudate becomes septic.

These types thus represent stages of a single disease process, and the type which obtains in a given case depends upon the nature and extent of the infection, or upon the degree of resistance possessed by the animal. Pleurisy may be primary or secondary to other disease conditions; primary pleurisy is of very rare occurrence.

ETIOLOGY.—In probably all cases bacteria are concerned in the production of pleurisy. The disease frequently complicates pneumonia, and may also result from trauma of the chest walls. It also occurs in general infections, particularly septicæmia, and in nephritis, in perihepatitis, and other forms of peritonitis, in which the infection may spread through the diaphragm to the adjacent pleura. Influences which lower the normal powers of resistance to disease—malnutrition, over-exertion and fatigue, exposure to cold and wet, debilitating diseases—are predisposing causes.

(1) **FIBRINOUS, PLASTIC, OR DRY PLEURISY—SYMPTOMS.**—The symptoms are not regular or constant, especially when pleurisy occurs as a complication to pneumonia. The onset is usually marked by rigors, a rise in temperature, and frequently by evidence of acute dyspnoea, and even pain, which may be so severe as to suggest colic. The pain is particularly evident on movement, which may occasion the animal to grunt or groan. There is, therefore, marked disinclination to move, and this has led to a mistaken diagnosis of laminitis. The pulse is quick, hard and wiry, the respirations are accelerated and abdominal in type (see p. 13). The cough, when present, is short, dry, painful and suppressed. Upon palpation of the chest wall a fibrillary thrill, synchronous with respiration, may be appreciable. Percussion, especially on the intercostal spaces, may induce pain, but there is no abnormality in the percussion sound. Auscultation may reveal friction sounds, which are usually more evident during inspiration, but the period during which these occur is of short duration, and they are easily overlooked. The majority of cases of dry pleurisy proceed, after a short course, to pleurisy with effusion.

(2) **SERO-FIBRINOUS PLEURISY—SYMPTOMS.**—Upon the occurrence of pleuritic effusion the syndrome undergoes a marked change. The discomfort and painful symptoms disappear, because of the separation of the inflamed pleural surfaces; the pulse becomes softer in quality, and the patient appears easier and brighter generally; but if the effusion increase rapidly, dyspnoea again becomes apparent, because of the pressure of

the fluid mechanically compressing the lung. The respirations are less accelerated, but are forced and laboured; the expiratory effort is prolonged, and consists of two distinct movements.

In severe cases the general symptoms of extreme dyspnoea may be present. Percussion no longer elicits tenderness and pain, but an area of wooden dulness corresponding to the area of effusion is appreciable over the lower part of the chest. Auscultation reveals complete dulness over the effusion. The horse usually remains standing throughout the course of the illness.

Cases of dry pleurisy which do not proceed to effusion may recover within a few days, but in sero-fibrinous pleurisy, if the effusion be considerable, a period of several weeks may elapse before its resorption is complete.

(3) EMPYEMA—SYMPTOMS.—If the pleuritic effusion become septic, the general systemic symptoms are aggravated; the pyrexia usually reaches a higher level, but is remittent in type. Exploratory puncture and withdrawal of a quantity of the fluid reveals its purulent character. The development of empyema must be regarded as a grave complication.

TREATMENT OF PLEURISY.—The general principles of treatment are those indicated on p. 432 for pneumonia, of which pleurisy usually occurs as a complication. During the dry stage a mild application of mustard to the chest walls is of benefit, but in the effusive stage counter-irritation is useless, if not harmful; pain and distress, if severe, may be alleviated by chloral hydrate, given in bolus, or by enema. Formerly the practice of paracentesis thoracis (p. 473) was delayed until the effusion was extensive, but it is now recognized that, if the volume of the effusion be considerable, its immediate and complete removal is indicated.

The treatment of empyema lies within the province of surgery.

Hydrothorax.—This is a condition characterized by the transudation of a clear, non-inflammatory fluid into the pleural cavity. Hydrothorax is due to passive transudation from the capillaries, and may arise from organic changes in the heart or kidneys, or from chronic pulmonary lesions. It is also met with in certain forms of anæmia. Hydrothorax is usually a manifestation of a general dropsical condition, and is commonly associated with ascites (see p. 418).

SYMPTOMS.—Apart from the symptoms which arise from the primary condition upon which the hydrothorax depends, the syndrome resembles generally that of the later stage of pleurisy with effusion. If the primary condition be not of an inflammatory nature, the course is afebrile.

TREATMENT is on similar lines to that indicated for ascites (see p. 419).

B.—Cattle.

In cattle, a large proportion of cases of pneumonia and pleurisy are of tuberculous origin, but the treatment of respiratory affections other than these is on similar lines to those indicated for the horse.

C.—The Dog.

Catarrhal affections of the respiratory tract are of common occurrence in canine practice, especially in young dogs, but in these they frequently represent complications of distemper, and their treatment forms a part of the treatment of a specific infectious fever.

Acute Nasal Catarrh—CORYZA.—Apart from its occurrence as a complication of distemper, coryza is seldom observed in the dog.

ETIOLOGY.—Chill, and other factors which predispose to respiratory catarrh, permit of bacterial invasion of the nasal mucosa. The presence of *Pentastoma tænioides* in the nares may produce a severe nasal catarrh, but the parasite is of rare occurrence in this country.

SYMPTOMS.—The nasal mucosa is at first dry and congested. There soon appears a serous discharge from the nostrils, accompanied by some lachrymation and sneezing. The discharge then becomes muco-purulent. The condition is usually, but not invariably, only slightly febrile, which may serve to differentiate simple coryza from that complicating distemper.

TREATMENT (see p. 441).

Acute Laryngitis not infrequently occurs as a primary affection unassociated with nasal catarrh.

ETIOLOGY.—The causes may be similar to those which obtain in nasal catarrh, but the affection is very commonly associated with excessive barking.

SYMPTOMS.—The bark is altered, becoming gruff and hoarse, and if the pharynx be involved there may be some difficulty in deglutition. A dry, hacking cough occurs in paroxysms; the attack of coughing usually terminates in retching, when a quantity of frothy mucus may be ejected; these symptoms frequently lead the owner to suspect the presence of a fragment of bone, or other obstruction, in the fauces or œsophagus. The temperature may be somewhat raised, but there is usually little, if any, constitutional disturbance.

TREATMENT (see p. 441).

Chronic Laryngitis is of rare occurrence, but is occasionally met with as a sequel to the acute form. Although chronic cough

is frequently attributed to chronic laryngitis, it usually arises from other causes.

TREATMENT (see p. 441).

Acute Bronchitis—**ETIOLOGY**.—As in the horse, acute bronchitis usually occurs in general catarrhal affections of the respiratory tract (see p. 428). It is frequently associated with some degree of nasal catarrh, and is a precursor of broncho-pneumonia.

SYMPTOMS.—The symptoms, as in the horse, vary with the extent and severity of the affection. In simple bronchitis, involving only the larger tubes, there may be little, if any, systemic disturbance, but when the smaller bronchioles are involved (capillary bronchitis), the condition may be indistinguishable from pneumonia. In simple bronchitis, cough is a prominent symptom. It is at first short, hard, and distressing, but after a few days it becomes looser, and is accompanied by considerable expectoration. The greater part of the expectorate is swallowed, but a portion may be discharged by the nostrils. Sonorous and sibilant rhonchi, and in the later stages râles, are heard on auscultation.

TREATMENT (see p. 441).

Chronic Bronchitis.—Chronic bronchitis may occur as a sequel to acute bronchial catarrh, but often develops insidiously as a primary condition. There is little, if any, constitutional disturbance. Persistent coughing, accompanied by wheezing respiration, constitutes the most prominent symptom. The bronchial exudate is usually scanty, and the cough is dry and harsh in character.

TREATMENT (see p. 441).

Pneumonia.—Pneumonia in the dog must be regarded as a grave affection.

ETIOLOGY.—The predisposing and exciting causes of pneumonia in the dog are similar to those in the horse (see p. 430).

SYMPTOMS.—When broncho-pneumonia follows simple bronchitis, the temperature rises through several degrees, and the pyrexia, which is remittent in type, is accompanied by the general symptoms of fever. There is marked dulness and, later, prostration. Dyspnoea develops rapidly. The respirations are extremely laboured, and expiration is accompanied by puffing of the cheeks. The dyspnoea is not constant in degree, but exhibits remissions and exacerbations. The dog usually lies on the sternum, but, especially during the severe dyspnoeic periods, he frequently assumes a squatting posture, in which the direction of the body is almost perpendicular, and the fore-paws are placed between the thighs.

Because of the diffuse character of the pneumonic lesions,

and the limited area of the chest, especially in small dogs, percussion and auscultation furnish little information. There is almost complete inappetence, and weakness is rapidly progressive. In fatal cases the prostration becomes extreme, and finally passes into coma.

Treatment of Catarrhal Affections of the Respiratory Tract.

Since all catarrhal affections of the respiratory tract in the dog may be manifestations of distemper, the animal should be isolated in comfortable, dry, airy surroundings. He should not be exerted, but rested, and the appetite maintained by attractive food of a light and easily assimilated character.

TREATMENT.—The general treatment is discussed under 'Care and Management of Sick Dogs' (see p. 50).

SPECIAL INDICATIONS.

CORYZA requires little or no particular treatment. If severe, the inhalation of water vapour, preferably administered by means of a steam kettle, is beneficial. The inhalations may be medicated with such agents as terebene, eucalyptus, etc., but the addition of pungent volatile substances is often resented by the patient.

LARYNGITIS tends to spontaneous recovery, but simple electuaries, with a sweet base of treacle or honey, are usually readily taken, and effect considerable benefit.

ACUTE BRONCHITIS.—Apart from the general treatment indicated above, a rubefacient application to the chest—*e.g.*, camphorated oil, a mild application of mustard paste, or a cataplasm of kaolin and glycerin—is usually of benefit. In long-haired dogs, the coat should first be clipped; warmth to the chest may be maintained by a jacket of flannel or woollen knitted material. Bronchial exudation may be encouraged by saline and stimulating expectorants.

BRONCHO-PNEUMONIA.—As in the horse, the general principles for the treatment of acute respiratory affections should be followed. Apart from careful nursing (p. 50), which is of paramount importance, medicinal treatment is largely symptomatic (but see Sulphanilamide, p. 363). Expectorants are of little or no value. Medicated inhalations needlessly distress the patient. When dyspnoea is severe, inhalation of oxygen may be tried. There are usually indications for the employment of cardiac stimulants to counteract the failing heart's action. Camphor (1 to 2 grains) in olive-oil ($\frac{1}{2}$ to 1 drachm) may be given hypodermically and repeated at the discretion of the practitioner.

Caffeine and digitalis may also be employed. Subcutaneous injections of a warm solution of normal saline have proved of benefit in selected cases.

As in the horse, the principal object of treatment consists in nursing the patient's strength, and so permitting the natural powers of resistance to function effectively.

SPASMODIC ASTHMA.—Many cases of chronic bronchitis are referred to as asthma, but true spasmodic asthma is of rare occurrence in the dog. The cause and symptoms are similar to those which obtain in the horse, and treatment is on similar lines (see p. 433). The injection of adrenaline may, however, completely fail to alleviate the urgent symptoms in the dog, but the inhalation of amyl nitrite usually affords immediate relief. Syrups containing ephedrine hydrochloride frequently prove of benefit in preventing or controlling the severity of the spasms of coughing.

PLEURISY.—Pleurisy may complicate pneumonia, but probably in at least 90 per cent. of cases in the dog it is of tuberculous origin. An exploratory puncture may be made at the sixth or seventh intercostal space. The fluid is aspirated into a hypodermic syringe and submitted to bacteriological examination. A diagnosis of tuberculosis dictates the need for the immediate destruction of the animal on considerations both of humanity and of hygiene.

The general treatment of non-tuberculous pleurisy is similar to that for pneumonia. Paracentesis thoracis should be practised as soon as the volume of fluid is considerable (see p. 473).

DISEASES OF THE CIRCULATORY ORGANS

A.—Horses and Cattle.

Acute Pericarditis.—There are several types of acute pericarditis, notably FIBRINOUS or DRY, SERO-FIBRINOUS, and PURULENT. These really represent stages in a single pathological process. The sero-fibrinous type (pericarditis with effusion) is that most commonly recognized in practice. When septic changes occur in the effusion (purulent pericarditis) the condition is usually a manifestation of a general septic infection.

ETIOLOGY.—It is very doubtful whether pericarditis ever occurs as a primary affection. It usually arises as a complication to rheumatism, or to an infectious fever, such as influenza. Other conditions with which it is associated are pleurisy, pneumonia, septicæmia, tuberculosis, and purpura hæmorrhagica. Probably in all cases the immediate cause of the disease is microbic infection.

Traumatic pericarditis, due to the migration of a sharp foreign body from the œsophagus, stomach, or bowel, is of rare occurrence in the horse; but in cattle sharp foreign bodies not infrequently penetrate the reticulum and enter the pericardium.

SYMPTOMS—Dry Stage.—The onset may be marked by rigor, followed by a variable degree of fever; the pulse is quick and wiry, the cardiac impulse is augmented, and the heart-beat irregular. If the animal be exerted, cardiac palpitation is evinced. On auscultation of the heart, friction sounds may be detected. These have no particular relationship in time to systole or diastole. There is general disinclination for movement, and the respirations are shallow and abdominal in character. Occasionally a friction fremitus can be detected by palpation over the cardiac region.

Stage of Effusion.—When effusion occurs into the pericardial sac the fever abates, the cardiac impulse becomes weak and muffled, and in the case of extensive effusion the heart-beat can be detected only with difficulty. The pulse is markedly thready, intermittent and irregular; the area of cardiac dulness is very considerably increased; the respirations are laboured; venous pulse is observed in the jugular veins; œdematous swellings in the sternal and anterior abdominal region may also be present.

TREATMENT.—Perfect rest is essential. The diet should be light and somewhat laxative, and, if necessary, the movement of the

bowels should be stimulated by mild aperients. Further treatment is largely symptomatic. If dyspnoea and exudation be marked, diffusible stimulants are indicated. Hypodermic injections of strychnine are also useful, but these may be contra-indicated in the early stages in which the heart's action is excited. During the effusive stage, a sharp blister over the pericardial region is often beneficial. The administration of iodide of potassium is believed to facilitate the absorption of the effusion. In extensive effusion evidenced by dyspnoea, serious interference with cardiac action, and a small rapid pulse, paracentesis pericardii may be indicated.

B.—The Dog.

Pericarditis.—ACUTE SERO-FIBRINOUS PERICARDITIS in the majority of cases occurs as a secondary affection associated with tuberculosis. Very frequently it is accompanied by tuberculous lesions of the pleura and of the mediastinal lymphatic glands. Occasionally acute pericarditis occurs as a complication of distemper.

CHRONIC SERO-FIBRINOUS PERICARDITIS may occur as a sequel to the acute type, or it may assume a chronic form from the outset. It is generally associated with tuberculous pleurisy, and is believed to be more common than the acute sero-fibrinous type.

SYMPTOMS.—The symptoms are usually obscure. Dyspnoea is probably the first symptom to attract attention, and the degree of its intensity depends upon the volume of effusion present. When the effusion is extensive, compression of the heart and lungs is produced. The pulse is frequent and generally irregular, but later becomes small and weak.

After effusion has occurred, palpation of the cardiac region reveals a weak cardiac impulse, and when the amount of fluid is extensive the heart-beats may not be capable of detection.

By percussion an increase in the area of cardiac dullness can be determined. On auscultation the sounds of the heart are muffled, and can be heard only with difficulty. Complications, such as endocarditis, hydrothorax, and ascites, may be present.

TREATMENT.—In tuberculous pericarditis treatment should not be undertaken. In order to arrive at a diagnosis a bacteriological examination of a portion of the fluid removed by aspiration from the pericardial sac may be made.

In non-tuberculous cases the principles of treatment are similar to those advised for pericarditis in the horse (see p. 443). In the case of extensive effusion, the fluid should be removed by paracentesis.

DISEASES OF THE HEART

The pathology of the diseases of the heart in the domesticated animals has received extensive study, but the clinical manifestations of cardiac conditions are frequently obscure, and their precise interpretation is often a matter of extreme difficulty.

Cardiac irregularity may arise from functional disorder of a transient character, or it may depend upon structural changes in the heart or vessels, in which case it represents a permanent disability. It is therefore of importance that differential diagnosis between these two types of cardiac affection be made, and in point of fact, in a large proportion of cases, little else can be achieved in clinical diagnosis.

The polygraph and the electro-cardiograph have not been found of practicable application in Clinical Veterinary Medicine, and our observations are therefore limited to a physical examination of the patient.

For detailed information the reader is referred to works on Veterinary Medicine. In a book of this nature the subject can be considered only on very broad general lines.

Cardiac Arrhythmia.—Disturbances of the rhythm of the heart include palpitation, intermittency, tachycardia, bradycardia, and other irregularities of the cardiac action, and these may arise from diverse causes. Thus, palpitation may occur during convalescence from debilitating diseases, such as influenza. It may also be observed during an attack of acute dyspepsia, or arise as the result of excitement, especially in nervous, highly-bred horses; it may also occur in pericarditis, in bovine piroplasmiasis, and in organic disease of the heart. The occurrence of cardiac palpitation upon very slight exertion is an important clinical feature of anæmia.

Tachycardia may be physiological in that certain otherwise normal individual animals may exhibit an increased frequency of the cardiac rate. On the other hand, a pathological tachycardia may be associated with many forms of cardiac disease, with fever, and with degenerative changes in the vagi.

Bradycardia, while occasionally physiological, is also met with in aortic stenosis, degeneration of the myocardium, during convalescence in infectious fevers, and in digestive disorder.

Irregular cardiac intermittencies also occur under a variety of conditions. They are met with in debility during convalescence from infectious fevers, in simple dyspepsia, and in myocardial affections; but, while they may arise from reflex irritation of obscure origin, or from organic cardiac affections which are capable of spontaneous resolution, they also result from inflammatory conditions of the endocardium which occasion structural changes

of a permanent nature in the valves. Such changes, naturally, occasion a permanent disability. Organic lesions, involving the structure of the valves, are associated with the occurrence of cardiac murmurs (see p. 12), and the following table will assist in the diagnosis of the forms of valvular disease usually encountered:

	Palpation.	Auscultation.	General Symptoms.
<i>Aortic insufficiency</i>	Cardiac impulse strong. A thrill, diastolic in time.	A 'blowing' murmur which may accompany the second cardiac sound or take its place.	<i>Pulse</i> : Of the 'Corrigan' or 'water-hammer' type. A thrill in the carotid arteries. When compensation fails, cardiac palpitation and dyspnoea. Sometimes irregular respiration or a double expiratory movement.
<i>Aortic stenosis</i>	A systolic thrill over the base of the heart, simultaneous with the heart-beat. Cardiac impulse slow and forcible.	A prolonged systolic murmur, heard chiefly over the base of the heart. It covers the first sound of the heart, and is propagated into the carotid arteries.	<i>Pulse</i> : Small, slow, and regular. Vertigo in some cases. When compensation fails, mitral insufficiency may set in, and the symptoms of that condition are manifested.
<i>Mitral insufficiency</i>	Cardiac impulse forcible in compensation period; feeble when compensation fails. A systolic thrill of a purring character, simultaneous with the heart-beat.	A systolic murmur which wholly or partly obliterates the first sound of the heart. The second sound is louder than normal.	<i>Pulse</i> : Irregular, small, and intermittent, when compensation fails. Jugular pulse present. Dyspnoea, cough, oedematous swellings of limbs and dependent parts of the body.
<i>Mitral stenosis</i>	A presystolic thrill over the base of the heart, immediately preceding the cardiac impulse.	A diastolic murmur over the apex.	<i>Pulse</i> : Small and soft; in later stages weak, irregular, and intermittent. Respiratory disturbance similar to that in mitral insufficiency.

	Palpation.	Auscultation.	General Symptoms.
<i>Tricuspid insufficiency</i>	A systolic thrill in the region of the third to the fourth intercostal space.	A soft systolic murmur coincident with the pulse, best heard at the posterior border of the third rib, in the groove formed between the caput longum tricipitis and the chest wall.	A venous pulse. Ascites, hydrothorax, dyspnoea, vertigo, a cyanotic condition of the visible mucosæ.

TREATMENT.—In conditions in which structural changes have occurred, treatment in the horse and ox is impracticable, and on humanitarian considerations treatment is usually undesirable in the dog. As has been indicated, it is therefore necessary to determine whether the condition is a functional one and amenable to treatment, or whether organic lesions actually exist. Such differentiation, in the absence of definite valvular murmurs, is often a matter of extreme difficulty, and frequently can be made only by repeated examination of the heart's action. If it be concluded that the condition depends upon functional disorder, treatment should be directed to the primary cause, but if that be obscure, recourse must be had to expectant treatment. The general principles of such treatment comprise complete rest, or at least the avoidance of undue exertion. Medicinal treatment is wholly symptomatic, and will be dictated by the circumstances by which individual cases are governed. Thus, stimulants (strychnine, caffeine), sedatives (the bromides, etc.), or cardiac tonics (digitalis, strophanthus) may each have their indications.

DISEASES OF THE NERVOUS SYSTEM

Manifestations of nervous disturbance in the horse and ox commonly arise from reflex stimuli having their origin in organs remote from the central nervous system—*e.g.*, the so-called 'stomach staggers'—or they may arise from disorganization of the neuro-muscular mechanism, as in milk fever which results from an acute hypocalcæmia, and as in lactation tetany which is associated with an acute hypomagnesiæmia. In calves acute nervous disturbances may reflexly result from the presence of foreign bodies in the abomasum. In all such cases treatment must be directed to the primary cause.

Nervous disturbances may also arise from inflammatory conditions of the brain and cord and their meningeal coverings.

Meningo-Encephalitis and Meningo-Myelitis—INFLAMMATION OF THE SUBSTANCE AND MENINGES OF THE BRAIN AND OF THE SPINAL CORD.

ETIOLOGY.—Apart from traumatic causes, meningo-encephalitis and meningo-myelitis occur as the result of microbial or virus infection, and are usually associated with specific infectious fevers such as influenza and distemper, and also with septicæmia. In cattle they are commonly the result of tuberculosis.

SYMPTOMS.—The clinical manifestations present marked variation, depending upon the structures involved. They are frequently vague and indefinite, and precise diagnosis is usually difficult, if not impossible.

When the brain is the chief seat of affection, the leading symptoms are frenzy, followed by dulness and coma. If the cord be the principal focus of attack, locomotor disturbances and paralysis are usually manifested.

Unless complete cure, unassociated with any permanent disability, can be obtained treatment is inadvisable, and immediate destruction is the proper course. On the other hand, the difficulty attending diagnosis of inflammatory affections of the central nervous system is such that tentative treatment may frequently be considered justifiable.

TREATMENT.—If treatment be attempted it must be largely on expectant lines. The patient should be placed in a large, roomy enclosure, and if maniacal symptoms of violent frenzy are present, the animal must be restrained from injuring himself. An attempt may be made to control the inflammatory process by

a derivative in the form of an active cathartic, or venesection may be practised. Cold water or ice packs may be applied to the head. Cannabis indica, chloral hydrate, and the bromides are commonly employed as sedatives, and are preferable for this purpose to opium; but medicinal treatment is wholly symptomatic.

In the secondary stages of spinal meningitis, when paralysis is in evidence, counter-irritation to the spine by means of a sinapism or mild blister may be employed. The administration of strychnine and iodide of potassium may also be tried. If necessary, the bladder must be relieved and the rectum regularly evacuated. If treatment meet with no response, and there be reasonable ground for the belief that inflammatory changes are in process, destruction should be advised.

Chronic Ossifying Spinal Pachymeningitis.—This condition is not uncommonly met with in the dog. It is characterized by a chronic inflammation of the dura mater, resulting in the formation of osseous plates which cause compression of the roots of the spinal nerves, and of the cord itself.

ETIOLOGY.—The etiology is unknown.

SYMPTOMS—Primary Phase.—The condition may be slowly progressive over a prolonged period without its producing observable symptoms of illness; these, in the earliest stage, are characterized by signs of sharp pain, especially when the animal rises, lies down, or makes any sudden movement of the neck or trunk. At this stage there is usually present an excessive extension of the limbs, so that the gait is stilted and awkward. Particular difficulty is shown in going up or down stairs. The muscular reflexes are also much exaggerated, and there is marked hyperæsthesia of the skin, mere stroking or light manipulation of the animal causing him to cry out in pain.

Secondary Phase.—The symptoms may pass off and the animal make an apparently complete recovery, or they may be succeeded by paralysis, which almost invariably affects the hind-quarters. The resulting paraplegia, which is attended by considerable muscular atrophy, may develop suddenly, or it may be slowly progressive. In rare cases, even when the paraplegia is complete, recovery may occur. In all cases of recovery, whether that result after the primary stage or, as is much more rare, after the development of paraplegia, a recurrence is to be expected, although a period of eighteen months or longer may elapse between the attacks. Upon recurrence the symptoms attendant upon the first stage are only slightly, if at all, in evidence, the recurrent attack being usually characterized by a progressive, and eventually permanent, paraplegia.

TREATMENT.—The treatment of the primary phase consists in

the administration of an active cathartic, followed by large and repeated doses of salicylates, preferably acetylsalicylic acid.

In the paraplegic phase careful and patient nursing is of paramount importance. The bowels may be moved by glycerin suppositories. Combinations of strychnine and iodide of potassium are frequently employed, but are of doubtful value. Electrical stimulation of the spinal region causes much alarm and distress and affords no benefit.

Treatment should not be pursued if, after a period of three to four weeks, no improvement of the paralytic symptoms be observed, and in the case of recurrence destruction is usually the more merciful course.

Epilepsy.—True epilepsy, of which neither the etiology nor pathology is known, is an obscure condition believed to be dependent upon an increased excitability of the cerebral centres. The term 'reflex epilepsy' is applied to a group of affections in which epileptiform convulsions constitute the most marked clinical manifestation. Reflex epilepsy is dependent upon peripheral or visceral irritation, such as may be caused by parasitic irritation of the skin, by oto-acariasis, by the presence of a foreign body in the stomach, or by heavy infestation of ascarides in the small intestine.

True epilepsy is a comparatively rare affection in the dog, and possesses a hereditary diathesis. The epileptic seizures generally occur only at irregular and infrequent intervals. In the reflex type the seizures usually succeed each other at short intervals.

TREATMENT.—In true epilepsy a laxative diet is indicated, and one of the barbiturates or the triple bromides (potassium, sodium, and ammonium bromide) should be given to control the seizures. In cases in which the attacks quickly succeed each other chloral hydrate enemata may be administered.

In reflex epilepsy, the treatment must be directed to the primary cause upon which the symptoms depend.

The animal must, if necessary, be prevented from injuring itself during the seizures.

Canine Hysteria.—This term is applied to a condition of violent mental disturbance, characterized by a sudden onset, marked excitement, and hallucinations, resulting in manifestations of apprehension, terror, and maniacal behaviour.

ETIOLOGY.—The etiology is unknown. Several members of a kennel may be affected within the course of a few days, and this fact, in conjunction with the paucity of evidence that the disease is infectious, has suggested the possibility that the condition is of dietetic origin.

Symptoms indistinguishable from those of hysteria are not infrequently observed in association with ascaris infestation in young dogs and with oto-acariasis, but in many instances the cause of the attack remains entirely obscure.

SYMPTOMS.—The duration of the attack varies from a few minutes to one or more hours. The symptoms in individual cases present great variation. Signs of excitement and fear are accompanied by a persistent yelping bark. Hallucination and frenzy may cause the animal to attack furiously inanimate objects, or occasionally persons, even those for whom he possesses deep affection. Frequently the distracted animal seeks to hide himself in inaccessible places, where, except for a querulous, persistent bark, he remains comparatively quiescent. In some cases the animal is the subject of periodic recurrences over a period of several days.

TREATMENT.—The attack is frequently so sudden, unexpected, and alarming, that the dog's excitement extends to his owner, whose alarm in turn is communicated to the dog, and occasions exacerbation of the symptoms. On the other hand, in many cases the attack will rapidly subside under a quiet, firm 'approach' on the part of the owner, or of some person in whom the dog normally has complete confidence. Sedatives—one of the barbiturates, morphine hypodermically, or chloral hydrate enemata—are indicated. After the attack has passed off, the dog almost invariably regains complete normality, but it is then advisable to administer an active aperient and to effect a complete change of diet.

CERTAIN SPECIFIC DISEASES.

EQUINE INFLUENZA.

Influenza is an acute catarrhal infectious fever.

ETIOLOGY.—The etiology is unknown, but there is reason to believe that a virus, or possibly a group of viruses, represents the primary cause. The affection is peculiarly liable to complications due to the extension of the catarrhal process.

SYMPTOMS.—The symptoms are those of an acute catarrhal fever. The pyrexia is usually severe, and apart from its usual concomitant clinical manifestations is associated with pronounced physical weakness and general debility. Complications may be represented by laryngitis, pharyngitis, septic adenitis of the sub-maxillary glands, bronchitis, pneumonia and intestinal catarrh.

TREATMENT.—No particular line of medicinal treatment can be advised; indeed, the course of the disease cannot be influenced, except to a very limited degree, by drug therapy.

Upon the first appearance of illness, the animal should be removed from the working stud and placed in isolation. In simple uncomplicated cases, the general principles of treatment indicated for catarrhal affections of the respiratory tract (see p. 430) should be followed. Complications are treated as they arise. Their treatment is indicated under their respective headings.

Attention may be particularly directed to the following points:

When pyrexia is severe, it may be controlled by mild febrifuges, but drugs which exert an antipyretic effect because of their action as heart depressants should be avoided.

In common with other febrile conditions, influenza may be associated with some degree of constipation, but purgatives are contra-indicated, as horses suffering from acute catarrhal affections are peculiarly susceptible to superpurgation. The bowels may be moved by laxative food—*e.g.*, bran and linseed mash, combined with treacle—supplemented by enemata and by small doses of salines.

A number of anti-influenza vaccines and sera are prepared, but the results of their application have been disappointing.

DISTEMPER.

Distemper is a panzootic specific catarrhal fever to which young dogs are particularly susceptible.

ETIOLOGY.—Its primary cause is a filterable virus, and, like influenza, to which it bears much resemblance, it is commonly associated with the development of serious complications.

It should be realized that distemper *per se* is an affection from which the majority of cases make rapid and complete recovery. Provided the subject be robust, that he can be nursed under satisfactory conditions, and that treatment can be adopted in the early stage of the disease, serious complications (to which the great majority of fatalities are due) are unlikely to arise.

SYMPTOMS.—The syndrome is characterized by pyrexia and its clinical concomitants, particularly anorexia, lassitude and general malaise.

Coryza and some degree of catarrhal conjunctivitis are constant features of the early phase. Under appropriate care and treatment these symptoms may pass off in the course of a few days, or the condition may proceed to a general catarrhal infection involving the respiratory and/or alimentary tracts, and resulting in such complications as laryngitis, bronchitis, pneumonia, or gastric and intestinal catarrh.

The catarrhal process may be associated with serious nervous

disturbances, such as acute epileptiform convulsions and chorea; these, however, usually arise as a sequel to the acute febrile attack, following the passage of the virus through the vasculomeningeal barrier.

TREATMENT.—The general treatment of distemper mainly concerns careful nursing (see p. 50). Anti-distemper serum (see p. 372) is of specific curative value, but the course of the disease is not appreciably affected by the employment of drugs. Medicinal treatment, which is wholly symptomatic, may, however, be applied according to the indications furnished by such complications as may develop.

The treatment of such complications as bronchitis, pneumonia, and intestinal catarrh is indicated on pp. 441, 441, 415 respectively.

The occurrence of epileptiform convulsions, or of chorea, as complications of, or sequelæ to, the attack is of such gravity that in the present state of our knowledge the immediate destruction of the animal should be advised as the most merciful course.

URTICARIA.

ETIOLOGY.—The urticarial eruptions of the domestic animals differ from the simple urticarias of man, in that they appear to be definitely non-inflammatory in character. They more closely approximate to the giant urticarias met with in hominine practice, and as such may be tentatively regarded as dependent upon a vasomotor neurosis. The cause of such neurosis may be assumed to be an autotoxin, an extraneous protein, or other toxic substance to which the animal is peculiarly sensitive.

In the horse and dog, urticarial eruptions have been observed to follow periods of acute nervous excitement. The simultaneous occurrence of several cases of urticaria in a stud or kennel suggests that the affection may have its origin in toxic substances in the food, but in many instances the cause of the attack is quite obscure. That certain persons who are subject to urticarial eruptions also possess an asthmatic diathesis is well recognized, and it is possible that many, if not all, of the urticarias of the domestic animals represent anaphylactoid phenomena.

SYMPTOMS.—In the horse the eruption is characterized by the sudden development of discrete, flat or convex, sharply delimited patches of œdema. They present marked variation in size, and measure from about $\frac{1}{4}$ inch to 2 or 3 inches in diameter.

A similar condition occurs in the dog, but in this animal the eruption may also be manifested by a diffuse swelling confined to the region of the face and head. In such cases the effusion may extend to the fauces, and asphyxiation may follow the development of œdema glottidis.

In the cow, diffuse and extensive swellings, principally affecting the perineal and mammary regions, are exhibited.

An urticarial eruption may disappear within a few hours, but the diffuse œdemas usually persist for two or three days.

TREATMENT.—The disease is usually benign in character, and treatment is simple. The bowels are evacuated by gentle aperients and, especially in the case of the horse and dog, the patient should be kept in quiet surroundings and nervous excitement avoided. In persistent cases, the subcutaneous injection of atropine or adrenaline may be tried with the object of overcoming the vagotonia which (upon the concept of the pathology of urticaria as here indicated) may be assumed to be present.

EQUINE PURPURA—PURPURA HÆMORRHAGICA.

The disease of the horse known as purpura hæmorrhagica usually occurs as a sequel to influenza, strangles, and other infective conditions.

ETIOLOGY.—The etiology is unknown. Although the non-infectious nature of the disease was demonstrated by Hering ninety years ago, equine purpura is still classed by veterinary authors with the infectious fevers.

It is becoming increasingly clear that equine purpura is allied in its pathology to the urticarias. The reduction of blood-platelets and the non-retraction of clot are signs which characterize true purpura hæmorrhagica in man, and serve to distinguish it from the anaphylactoid purpuras. These signs are not present in equine purpura, in which condition the nature and appearance of the œdematous swellings are strongly suggestive of an angio-neurotic œdema, such as occurs in giant urticaria. It may be tentatively postulated that purpura hæmorrhagica is probably allied to those effusive conditions known to be associated with vagotonicity, and may represent a form of anaphylactic shock; thus we might assume that in the primary disease the tissues are sensitized to certain extraneous proteins, possibly represented by bacteria or their toxins, and that after the establishment of sensitization further specific protein is absorbed, determining the manifestation we call purpura hæmorrhagica.

This assumption is supported by the experience of Marek, who administered to a horse several subcutaneous injections of a streptococcal extract, followed after an interval of one month by one further injection of the same extract; in seven days typical symptoms of purpura hæmorrhagica developed, and a fatal termination resulted.

It is further supported by the fact that adrenaline (which, by

stimulating the sympathetic, overcomes vagotonicity) appears to act beneficially in many cases of purpura hæmorrhagica.

SYMPTOMS.—Equine purpura is characterized by the development of petechial hæmorrhages on the mucous membranes of the anterior nares, the lips, and the conjunctiva, and by the sudden appearance of extensive non-inflammatory subcutaneous effusions. The effusions may occur as discrete circumscribed areas, or (especially when involving the head) as extensive swellings, which, however, still retain definite delimitations. The swellings may suddenly disappear in one location, and appear in another. The lungs and the intestinal mucosæ may also be the site of effusion. Direct stimulation of the skin, such as that occasioned by pressure, friction, or needle prick, quickly produces effusion at the site of the stimulus—a condition reminiscent of factitious urticaria in man. Lesions of the skin have a tendency to become necrotic.

During the early phase of the disease there may be little or no systemic disturbance, but later a condition of general malaise develops, accompanied by loss of appetite and periodic aberrations in temperature and pulse-rate.

The course is usually prolonged—it may extend from a few days to several weeks—and the mortality incidence is high.

TREATMENT.—Careful nursing under hygienic conditions constitutes a factor of prime importance in the treatment of purpura, and such clothing as may be worn should be light and loosely applied. Subcutaneous injections of 1 drachm of the *Liquor Adrenalinæ Hydrochloridi* have been employed. The injection should be repeated two or three times daily. Atropine, because of its action in depressing vagotonicity, may also be tried.

Iodine appears to exert certain beneficial effects in purpura, and is commonly administered daily in the form of potassium iodide. The beneficial action of iodine is not understood, but may be due to its effect on thyroid secretion. Many drugs, including sulphanilamide, oil of turpentine, the iron preparations, potassium chlorate and the salicylates, are commonly employed. The use of polyvalent antistreptococcal sera has also been advised.

Practitioners have considered that benefit has been obtained from the adoption of one or other of these measures, but our knowledge of the therapeutics of equine purpura is in a highly unsatisfactory state.

Careful nursing and general management must be observed throughout the course of the disease and during the protracted period of convalescence, and the horse must not be returned to work until complete recovery is established.

LYMPHANGITIS—'WEED.'

Lymphangitis occurs principally in heavy draught horses, and usually succeeds a period of idleness and full feeding. It is also met with in horses that are not undergoing regular work, and that have been suddenly given a highly nitrogenous diet to which they are unaccustomed.

ETIOLOGY.—While the circumstances under which the disease is likely to occur are well recognized, the cause and pathogenesis are not yet defined.

SYMPTOMS.—In the early stages of acute cases well-marked rigors, fever, a full, rapid pulse, and accelerated respirations are exhibited. These phenomena are followed by severe lameness in one limb (usually a hind-limb), which is markedly abducted during movement. On palpation of the inguinal lymphatic glands these are found to be swollen and acutely painful, and if firm pressure be applied, the limb is sharply abducted. The swelling soon extends downwards over the greater part of the limb. The constitutional disturbance, the pain and lameness persist until the local inflammatory condition has reached its full development, after which improvement is progressive. The affection tends to recur, and after two or more attacks a permanent enlargement of the limb is likely to result ('elephantiasis').

TREATMENT.—If the case be seen in the early stages, and if rigors be present, a diffusible stimulant, such as sweet spirit of nitre, may be given, and warm clothing applied. A saline aperient (8 to 12 ounces of sodium sulphate) should then be administered. The diet should be light and laxative in character.

Local treatment consists in warm fomentations to the limb, succeeded by the application, as high up as possible, of a soft hay band; this should not be applied too tightly. Much harm may be done by the use of excessively hot water. The temperature of the fomentation should not exceed 115° F. The animal should not be exercised until the fever has subsided and until the limb can be used with some freedom; gentle exercise then proves beneficial by promoting absorption of the exudate. When the acute symptoms have abated, gentle massage applied to the part is of advantage. In chronic cases associated with permanent thickening of the limb, treatment is of little avail.

PROPHYLAXIS.—In the prevention of lymphangitis, attention should be directed to proper exercise and to dieting. Horses unavoidably remaining idle in the stable should be fed on a soft, laxative diet, and regularly exercised. Such precautions are especially necessary in the case of animals which are known to have suffered previously from an attack of the disease.

TETANUS—LOCKJAW.

Tetanus is an acute infective disease due to a toxin elaborated by *Clostridium tetani*. It is characterized by severe tonic spasms of the voluntary muscles, including those of the jaws (trismus). While subacute cases of the disease are amenable to treatment, peracute cases which develop after a relatively short incubative period, and in which trismus occurs early, almost invariably succumb.

TREATMENT.—The horse should at once be removed from work, and placed in a quiet, darkened, roomy loose-box. While attentive nursing is of very high importance, all undue excitement of the patient must be avoided. Because of the difficulty in prehension, the food should be soft or, preferably, semi-fluid in character and easily digestible. Milk gruels or milk alone may be allowed *ad libitum*. Recourse may be had to peptonized nutrient enemata, but if possible the natural appetite should be maintained by offering palatable and attractive food in small quantities. The bowels may be moved by small repeated doses of saline aperients given in the food. The bedding should be composed of sawdust or peat-moss litter, as, because of the stilted gait which results from the spastic contraction of the limb muscles, the movements may be still further hampered if long straw be employed.

The discovery and surgical treatment of the infected wound are of first importance. Necrotic tissue should be completely removed, and the wound cavity sterilized. In cases occurring after the operation of 'docking' a further portion of the tail should be amputated.

Numerous nerve sedatives and antispasmodics, of which chloral hydrate and cannabis indica are among the more important, are employed, but these should not be given as draughts, and even the administration of a bolus may seriously excite the animal. Medicine should, therefore, be given in the food and drinking water, in electuary, in enemata, or by subcutaneous or intravenous injection.

The desirability of slinging the patient is a matter which must rest with the discretion of the practitioner. If they do not unduly excite the patient slings are of advantage, in that they afford considerable rest and obviate the danger of decubitus resulting from exhaustion; but in some instances slings produce such a degree of excitement that they may seriously militate against recovery.

Marked benefit results from the employment of antitetanic serum, but the serum must be injected in large doses (10,000

to 30,000 immune units). The dose usually employed (3,000 to 6,000 immune units) is inadequate.

[In a severe case of acute tetanus in a heavy draught horse which came under the writer's observation, 770 c.c. of antitetanic serum, equivalent to 231,000 immune units, were experimentally injected intravenously over a period of four days. The case made a rapid and uneventful recovery.]

The spasms of experimentally produced tetanus can be controlled by the intraspinal injection of magnesium sulphate, and Dawson and others have used this agent in the treatment of tetanus in the horse. The sulphate of magnesium is used as a saturated solution, and is injected hypodermically in doses of 40 c.c. (20 c.c. is injected behind the shoulder on each side of the body). The injections are repeated in three hours, and then given twice daily until the twelfth day, when the dose is reduced to 20 c.c. daily and continued until the eighteenth day.

In the great majority of cases which recover from tetanus convalescence is protracted.

PROPHYLAXIS.—Antitetanic serum is of specific prophylactic value. In valuable horses it is advisable to inject the serum in all cases of accidental wounds, but especially in punctured wounds of the limbs and feet, as these are very liable to become contaminated by fæces, in which the tetanus bacillus is commonly present.

The prophylactic dose is 500 to 1,500 immune units. 500 units should suffice if injected within twenty-four hours after inoculation; a further 500 units should be injected for each twenty-four hours following the probable time of inoculation. An additional injection of 500 immune units should be given after an interval of fourteen days.

Active immunity may be conferred by the injection of tetanus anatoxin (p. 369).

EQUINE HÆMOGLOBINURIA—MYOGLOBINURIA (*'AZOTURIA'*).

This affection is characterized by the well-defined conditions which govern its occurrence, by the acuteness of the attack, which is manifested in marked locomotor disability, by rapid pathological change in certain voluntary muscles, and by discoloration of the urine with myohæmoglobin.

ETIOLOGY.—The disease occurs after a period of enforced idleness, during which the horse receives a full diet rich in carbohydrates. Upon his being returned to work, especially if this be of a strenuous nature, the attack usually develops within thirty to sixty minutes.

The pathology of the condition is still obscure. The name 'azoturia,' which was applied to the disease under the erroneous belief that the affection was associated with an excessive excretion of urea, is highly misleading, and should be abandoned.

According to Carlström, during the period of rest muscle glycogen is deposited in excess, especially in those muscles which are not directly concerned in the maintenance of the standing posture and have, therefore, been least active. The glycogen deposit reaches its maximum at about the third or fourth day.

When the horse is suddenly called upon to undergo strenuous exertion the glycogen is rapidly converted into sarcolactic acid. If this be in such excess that it cannot be quickly enough removed and neutralized in the blood, it attacks the muscle cells, in which coagulation and degenerative changes result, with consequent liberation of muscle pigment (myohæmatin). Nephritis has been observed in many cases of equine hæmoglobinuria, but is of only secondary significance.

SYMPTOMS.—As has been indicated, the disease develops shortly after the horse has been required to undertake strenuous exertion, and the animal is therefore usually attacked when at work. There is first observed difficulty in progression, due to a condition suggestive of flexion tetany, the fetlocks being principally affected; a crouching posture is assumed, and sweating is profuse. These symptoms are accompanied by signs of extreme distress, and the symptoms may be readily mistaken for those of colic. Discoloration of the urine is soon evinced.

If the horse be not immediately rested, the symptoms progress in their intensity; the animal becomes unable to stand, and falls to the ground, where he struggles convulsively in ineffectual attempts to regain his feet. The gluteals, and to a less extent other superficial muscles, become tense and rigid, due presumably to acid rigor.

TREATMENT.—If upon the first appearance of the symptoms the horse be immediately rested, recovery may be rapid and spontaneous. The animal should, therefore, be conveyed home by ambulance, or, if this be not practicable, he should be slowly walked to the nearest available stable. It is essential that all exertion on the part of the patient be reduced to a minimum. The animal should then be warmly clothed and rendered as comfortable as possible. Although the appetite may persist through the entire course of the disease, the diet should be of a light, non-nitrogenous nature, and careful nursing is of paramount importance. As the urine is usually retained, the catheter may be passed, or, in the case of the mare, micturition may be induced by gently dilating the urethra with the fingers. An

active cathartic (aloes in solution, arecoline or physostigmine), followed by the administration of mild diuretics (potassium acetate), should be employed with the object of stimulating the excretory functions. Local applications to the affected muscles are of benefit, and warm cataplasms composed of kaolin and glycerin, covered with layers of cotton-wool overlaid with a woollen blanket, may be usefully employed. Irritant applications are harmful. When the animal is decumbent and unable to rise, a large bed of straw should be provided. He must be turned from side to side every three or four hours. Because of the continuous struggling which is often exhibited by decumbent cases, it is particularly necessary that the patient be constantly attended in order to prevent his injuring himself. If necessary, the bladder and rectum should be evacuated at proper intervals.

On the second or third day, if the animal be still unable to rise, an attempt should be made to assist him to his feet by means of slings, but if no weight can be borne by the hind-limbs, slinging should be abandoned. In cases in which inability to rise persists beyond the third or fourth day prognosis is very grave, and although such cases may occasionally recover, destruction, if only for economic reasons, must be seriously considered.

A large number of drugs are employed in the treatment of equine hæmoglobinuria, but their use is empirical, and in many cases entirely irrational. Considerable success, however, has been attributed to the administration of insulin in doses of 200 units three times daily for 2 or 3 days, and thereafter once or twice daily till substantial progress towards recovery has been made.

PROPHYLAXIS.—During periods of enforced idleness the diet should be reduced to a subsistence ration, and daily exercise ordered.

BOVINE PIROPLASMOSIS—RED-WATER IN CATTLE.

ETIOLOGY.—Bovine piroplasmosis as it occurs in the British Isles represents an infection by *Babesia bovis* (*Piroplasma divergens*) and *Babesia bigemina*. The vectors of infection are the ticks *Ixodes ricinus* and *Hæmophysalis punctata*. The disease occurs most commonly during spring and early summer—i.e., those seasons in which the ticks exhibit their maximum activity—but the clinical manifestation of the disease may be precipitated by such factors as cold and damp.

SYMPTOMS.—The condition in its early phases is characterized by fever, which at first is of a remittent type. There is loss of appetite, suspension of rumination, decrease in milk secretion and general malaise. Profuse diarrhoea is commonly present,

but is soon succeeded by obstinate constipation. The urine is highly albuminous, and on being voided forms a voluminous, tenacious froth; later it becomes discoloured, due to its containing hæmoglobin and its derivatives, the hæmoglobinuria resulting from the rapid destruction of red blood-corpuscles by the parasite. The cardiac action is frequently tumultuous, and violent palpitation may occur. The visible mucosæ are anæmic, and may also exhibit icteric discoloration (hæmolytic jaundice). Weakness and emaciation are progressive, and in fatal cases the temperature becomes subnormal. Favourable symptoms are observed in the recommencement of gastric and intestinal action, the disappearance of the discoloration of the urine and the return of appetite. Individual cases present great variation in the intensity of the attack.

TREATMENT.—The affected animal must be taken up from pasture and suitably housed. A careful search should be made for ticks, which are removed and destroyed; the parasites are usually located on the inner aspects of the thighs and forelegs, on the under-surface of the neck, on the inferior aspects of the thorax and abdomen, and also on the udder and perineum.

The diet should be light, and with the object of protecting the liver and conserving the tissues readily assimilable carbohydrates, such as treacle or glucose, should be well represented.

The remedial effect of sodium chloride in the treatment of red-water is well recognized, and this agent is given with benefit in aperient doses even during the early stage of diarrhoea; but it is now believed that its value is due to some action other than that of purgation, and it is conceivable that the acid radical, the chloride, may exert some specific effect. This view is supported by the fact that magnesium sulphate and sodium sulphate, although purgative, possess much less therapeutic value. That some degree of anhydræmia exists is suggested by the benefit which follows the administration of fluids, and the specific action of sodium chloride has been partly explained on the ground that it creates thirst.

In view of these considerations, treatment may be commenced by administering 10 to 12 ounces of sodium chloride in water, but because of the difficulty in administering draughts to animals affected with red-water, the agent may be given by stomach-tube. This is followed by repeated small doses by mouth, or normal saline, alternated with full doses of glucose (see p. 338), may be given subcutaneously.

Trypan blue in doses of 15 to 30 grains, prepared in the form of a 1 per cent. aqueous solution and injected intravenously or subcutaneously, has been used with success in the tropical forms

of piroplasmosis, but it has not been found of value in the British type of red-water.

Tartar emetic has proved of very considerable value in the treatment of piroplasmosis, and 2 ounces of a 2 per cent. aqueous solution may be injected intravenously and repeated after an interval of twenty-four hours.

Recently considerable success has attended the use of urea derivatives in the treatment of British red-water.

PROPHYLAXIS.—One attack of piroplasmosis furnishes the animal with a considerable degree of tolerance to subsequent infections. The blood of recovered carrier cattle may be inoculated subcutaneously into calves in doses of 10 to 20 c.c. The inoculated calves are isolated for a period of about two weeks until recovery from the infection is established.

It is impossible to exterminate ticks from permanent pastures, as even if stock be entirely withdrawn the parasites find suitable hosts in small wild mammals and birds; but tick-infested pastures may be cleaned by putting them under arable cultivation.

THE HYPOCALCÆMIAS.

PARTURIENT HYPOCALCÆMIA OF COWS—'MILK FEVER.'

ETIOLOGY.—'Milk fever' is due to an acute calcium deficiency of the blood and tissue fluids.

The colostrum of the cow is very rich in calcium, and one-half gallon of colostrum contains the equivalent of the total amount of calcium normally present in the soft tissues. Hence during the first phase of lactation the blood calcium must be rapidly replenished from the calcium reserves in the bones. The calcium in these skeletal reserves exists in a form which cannot be immediately ionized by the tissues, but the parathyroid secretion is capable of effecting the change, rapidly converting 'bone calcium' into 'blood calcium.'

The mechanism is one of exquisite delicacy, and if during the onset of lactation the parathyroid does not function perfectly the mobilization breaks down. The calcium in the blood is rapidly depleted, being lost in the milk; it is not quickly enough replenished from the bones, and acute hypocalcæmia results.

The conditions under which 'milk fever' occurs can therefore be readily understood. The disease usually appears within the first seventy-two hours after calving, and the most common

subjects of attack are those cows in which there occurs a rapid development of profuse lactation; heifers and second calvers are therefore rarely affected, but mature cows possessing deep milking qualities, especially those in which parturition has been simple and uncomplicated (and full lactation has therefore quickly developed), are readily susceptible to the disease.

SYMPTOMS.—In the earliest stage the symptoms are those of restlessness accompanied by excitement. Tetany is early evinced; the limbs (particularly the hind limbs) are moved stiffly and the gait is stilted and awkward. The excitement increases in its intensity, and convulsive seizures may cause the animal to fall to the ground, from which she rises with difficulty. There is now marked trembling and purposeless inco-ordinate movement, and if the cow be unrestrained her gait is staggering and blundering. The difficulty of keeping her balance becomes increasingly acute, until, after falling and making several ineffectual attempts to rise, she remains decumbent. These symptoms give place to a condition of somnolence, which usually rapidly develops into complete coma. Unless supported, the animal lies prostrate; the head is often laterally retracted, with the face firmly pressed against the shoulder. If the neck be forcibly straightened, the head upon release soon returns to its former position. Even during deep coma the presence of extensor tetany, particularly of the hind limbs, persists. The breathing is stertorous and laboured; the stomach and bowels are completely inactive; and gaseous distension of the rumen may occur as a serious complication. The swallowing reflex is markedly depressed or entirely absent, and draughts of medicine, which at this stage may be administered by the attendant, are not swallowed naturally, and there is therefore grave risk of such fluids being inhaled.

In a considerable proportion of cases the early phase of excitement may be so brief and slight as to pass unobserved, the case quickly lapsing into a condition of coma.

TREATMENT.—The disease was attended by a very high mortality until 1897, in which year Jürgens Schmidt discovered that the intramammary injection of fluids effected a marked curative response. It was later found that Schmidt's original method could be improved by the substitution of gaseous insufflation of the gland for the intramammary injection of fluids, and by this method the mortality from the disease was reduced to a low figure.

The action of mammary insufflation appears to depend upon the consequent increased intramammary pressure arresting the transference of calcium from the blood to the milk, as intra-

mammary insufflation is followed by a rise in the blood-calcium concentration, which bears an intimate and direct relationship to the process of cure in that the blood calcium rises *pari passu* with the disappearance of the symptoms.

Mammary insufflation, while of great therapeutic value, has been largely replaced by the parenteral injection of readily assimilable calcium compounds because, among other reasons, this procedure occasions no interference with the mammary gland at its most delicate functional phase.

CALCIUM THERAPY.

The calcium salts employed are the gluconate (in the form of CALCIUM BORO-GLUCONATE), the chloride and the lactate.

CALCIUM GLUCONATE.—A quantity of 2 to 3½ ounces of calcium gluconate and 3 to 5 drachms of boric acid are dissolved in 12 to 14 ounces of boiling water (Calcium Boro-Gluconate; see p. 125). The solution is then cooled to about 115° F. immediately before administration, which may be either subcutaneously or intravenously.

If the subcutaneous route be adopted the injection is made at two points—one on each side of the posterior third of the neck. The site of the injection is gently massaged, pressure being mainly directed towards the head. The injection may be made by means of a large syringe to which is attached by a short piece of rubber tubing a No. 14 to No. 16 needle (see Appendix II); or simple gravitation may be employed. The injections should be made under strict aseptic precautions. Calcium therapy is usually followed by rapid recovery, but warm clothing may be desirable as the body temperature is usually subnormal.

If the injection be made intravenously (p. 101) almost complete recovery, even in very severe cases, may result within a few minutes. The treatment therefore constitutes one of the outstanding examples of specific therapy in human and in veterinary medicine.

Solutions of calcium boro-gluconate are also prepared commercially; these should be warmed at least to body temperature before injection.

CALCIUM CHLORIDE and **CALCIUM LACTATE**, if injected subcutaneously, are active topical irritants. These salts must therefore be administered intravenously. Care must be observed that the intravenous injections are perfectly performed, as leakage at the site of injection may induce serious local tissue necrosis.

Several fatal cases of 'heart block' have occurred following the intravenous injection of calcium chloride, and in view of the bland nature of calcium boro-gluconate the use of the chloride and lactate should be discontinued.

The practice of calcium therapy obviates interference with mammary function, such as may be occasioned by mammary insufflation. Following mammary insufflation the cow may not yield her full secretion of milk for seven to ten days, and if more than one insufflation be required her milk yield may be reduced throughout the period of lactation. The risk of septic mastitis, which occasionally develops as a sequel to mammary insufflation, is also avoided.

PROPHYLAXIS.—Highly susceptible cows may be subject to milk fever at several successive parturitions. The disease may be largely prevented by withdrawing the milk in small quantities at short intervals during the first seventy-two hours after calving, and so avoiding the complete emptying of the udder and the consequent sudden need for blood calcium in the production of milk; but even in very highly susceptible animals the attacks may be effectively prevented by the subcutaneous injection of calcium boro-gluconate ($1\frac{1}{2}$ to 2 ounces) immediately after calving and preferably repeated after an interval of twenty hours.

INTRAMAMMARY INSUFFLATION.

TECHNIQUE.—The apparatus employed in mammary insufflation consists of an air pump connected by rubber tubing to a metal chamber containing, as an air filter, a tampon of sterile cotton-wool. The chamber is in turn connected by rubber tubing to a 'teat tube.' The udder is completely milked and two or more folds of clean towelling placed beneath it. The mammae must be carefully examined for evidence of mastitis. Should this be present, the affected quarter, or quarters, must not be inflated. The 'teat tube,' which has previously been sterilized by boiling, is carefully inserted into the lactiferous duct, and the quarter is then firmly inflated with air. The procedure is repeated with the other teats. In order to prevent the escape of air, rubber rings or broad tape may be applied to the teats, and removed after an interval of an hour. This practice, however, is unnecessary, and even undesirable. When the udder is fully inflated gentle massage should be applied, and the towelling arranged so that the gland will not come into direct contact with the bedding. The cow is then supported by sacks firmly filled with straw, so that she may assume a normal recumbent position, and she should, if necessary, be turned from side to side every four hours, care being taken that the lower hind-limb is in proper position (that is, the foot visible in front of the udder) in order to avoid undue pressure upon the distended mammary gland.

The beneficial effects of the treatment may be apparent within

one hour, but twelve hours or longer may elapse before the cow has completely regained normality.

Intramammary insufflation with oxygen is also practised, but this procedure possesses no advantage, since the curative effect of mammary inflation is entirely dependent upon the mechanical distension of the gland and the consequent increase in intramammary pressure.

Whichever method of treatment is adopted, the milk should be drawn off in small quantities at short intervals during the first forty-eight hours succeeding recovery; but complete emptying of the udder must be avoided as this may in itself precipitate a recurrence of the attack.

PARTURIENT HYPOCALCÆMIA OF EWES—LAMBING SICKNESS.

The pathology of this condition is closely allied to, if not identical with, parturient hypocalcæmia in the cow, and the curative response to calcium therapy or mammary insufflation is common to both.

Lambing sickness presents much similarity to milk fever in its clinical manifestation and in its time relationship to parturition, but many cases occur in pregnant ewes, especially if these be subjected to fatigue or over-exertion, and cases are also encountered in ewes with young lambs at foot.

A subcutaneous injection of 2 to 4 drachms of calcium boro-gluconate dissolved in 3 ounces of water is usually sufficient to effect rapid recovery.

Lambing sickness is to be differentiated from pregnancy toxæmia, which is not associated with hypocalcæmia.

‘PARTURIENT ECLAMPSIA.’

The so-called ‘parturient eclampsias’ of the sow, the goat and the bitch are due to acute hypocalcæmia, and like lambing sickness resemble milk fever in their symptoms and time relationship to parturition.

TREATMENT.—Treatment consists in the subcutaneous injection of calcium boro-gluconate (goat and sow, 3 to 4 drachms; bitch 15 to 50 grains); calcium therapy is distinctly preferable to the alternative treatment of mammary insufflation, which in the case of the sow and bitch requires the insertion of a hypodermic needle (attached to a small air pump) directly into the substance of the gland.

Cases of acute hypocalcæmia in the cow occasionally occur at any stage of lactation (so-called 'delayed milk fever'). Such cases are commonly associated with œstrum and with the occurrence of excitement or fatigue. Similar cases are observed in the ewe and goat.

TRANSIT TETANY.

The name 'transit tetany' has been applied to a condition occurring in mares which have been transported by road or rail transit, or subjected to undue excitement or fatigue. The affection is observed particularly during the periods of œstrum and lactation.

ETIOLOGY.—While the nature of the pathogenesis of the disease is obscure, the immediate cause is represented in an acute hypocalcæmia.

SYMPTOMS.—The symptoms are those of tetany, involving the general superficial muscles, including the masseters. The tetanic spasm induces a stilted type of gait, and trismus is usually pronounced. The temperature is variable, but may be considerably elevated; the respirations are accelerated, and the heart's action may be tumultuous; sweating is usually profuse, and the animal exhibits very considerable general distress. The syndrome bears close clinical resemblance to that of tetanus, and the name 'fleeting tetanus' has been erroneously applied to the condition; but in transit tetany (in contradistinction to tetanus) protrusion of the *membrana nictitans* cannot be elicited.

TREATMENT.—The animal should be placed in a large airy loose-box, or preferably in an enclosure in the open. The symptoms usually quickly disappear upon the subcutaneous injection of 2 to 3 ounces of calcium boro-gluconate in warm aqueous solution.

In many instances cases of so-called 'staggers' in non-lactating cows and in bullocks appear to be due to acute hypocalcæmia in that the injection of assimilable calcium salts rapidly effects recovery.

HYPOMAGNESÆMIA OF THE COW—LACTATION TETANY, GRASS TETANY.

ETIOLOGY.—Lactation tetany is associated with an acute magnesium deficiency of the blood and tissue fluids. The cause of this hypomagnesiæmia is still unknown. A slight reduction in the blood calcium is also a common feature of the condition.

The disease, although widespread throughout Great Britain, is more prevalent in certain districts, and in some instances it occurs only on certain farms, and upon occasion only on certain fields. Lactation tetany commonly occurs soon after the commencement of the grazing season, and its incidence is perhaps greatest in those animals which are suddenly put out for the whole day as distinct from the proper practice, which consists in at first grazing them for very short periods, these being gradually lengthened each day. The disease is, however, quite frequently encountered in the winter and early spring months in lactating cows which are not at grass. It has also been observed in the virgin heifer and in the bullock.

SYMPTOMS.—The earliest symptoms are those of twitching of the superficial muscles, accompanied by general nervousness and restlessness. The gait soon becomes unsteady and whether in walking or at rest the hind limbs are carried wide apart. The behaviour may become violent and, indeed, uncontrollable, especially if the cow be forcibly driven some distance—for example, when she is brought in from pasture for milking. When such a condition develops ability to maintain stance may be lost and the animal falls to the ground, where she lies struggling vigorously.

During the paroxysms of struggling the teeth are gnashed and profuse salivation results; on occasion trismus is evident. Rolling of the eyeballs and loud bellowing are frequently observed. The limbs are in a condition of intense extensor tetany, and the conformation of the body may be distorted. Generalized convulsions almost invariably precede death.

The course is usually of very short duration; only a few hours may elapse between the first sign of observable illness and death. The mortality is high, but in a small number of cases recovery occurs spontaneously.

TREATMENT.—From what has been said it will be appreciated that treatment if it is to be of any avail must be promptly applied. The intravenous injection of a soluble salt of magnesium not infrequently results in rapid recovery. For this purpose $\frac{1}{2}$ ounce of magnesium chloride may be dissolved in 10 ounces of water and injected slowly into the jugular or other convenient vein; or, alternatively, $\frac{1}{2}$ ounce of magnesium sulphate dissolved in 10 ounces of water may be injected either intravenously or subcutaneously. A solution of calcium boro-gluconate, in doses similar to those employed in the treatment of milk fever, may with advantage be administered at the same time in order to correct the possible reduction in the blood calcium.

PROPHYLAXIS.—As a preventive measure it is advised that at

the commencement of the grazing season cows should for several days be turned out to grass only for a short period each day.

Considerable success has attended the feeding of a mineral mixture containing 16 per cent. magnesium oxide with the object of providing an ample reserve of available magnesium. The mixture may be fed for a month previous to the commencement of the grazing season and continued for several weeks while the animals are at grass.

It has been stated that the course of lactation tetany is of very short duration, and, indeed, many cases of the disease which appear perfectly healthy one evening are found dead the next morning.

It is to be particularly observed that anthrax should be suspected in all cases of sudden death of unknown etiology which occur in bovine animals; such cases should be immediately notified to the local authority.

MINOR OPERATIVE PROCEDURES.

THE PROBANG.

Recourse is had to passage of the probang for the relief of acute œsophageal obstruction.

THE HORSE.—The most satisfactory form of probang is one composed of gum elastic. In many instances the instrument can be passed when the animal is in the standing posture, but nervous, excitable horses may require to be cast before the procedure can be performed with safety. One or preferably two assistants steady the horse's head. The probang is lubricated with soft paraffin or lard; a mouth speculum is inserted, and the probang is passed very slowly and carefully over the base of the tongue and epiglottis. The animal usually makes deglutitive efforts, and the instrument then readily passes into the œsophagus; when it reaches the foreign body gentle intermittent pressure should be applied, as the employment of force may induce œsophageal rupture. Care must be taken that the instrument does not enter the trachea, in which case it passes downwards comparatively easily, and a paroxysm of coughing is usually provoked. When the probang enters the œsophagus, it can readily be felt upon palpation of the left jugular furrow. The probang should not be employed when the œsophagus is impacted with dry ingesta. In such cases, if the condition cannot be relieved by

massage, œsophageal irrigation by means of the double stomach-tube (p. 471) is advised.

CATTLE.—A wooden perforated gag is fixed in the animal's mouth, and secured by a strap round the base of the horns. Two assistants steady the head and hold the arms of the gag. The method of passing the instrument is similar to that described for the horse. When the obstruction is reached, it may be gently pressed or tapped. Patience and care must be exercised. If the animal repeatedly and violently resists the procedure, the use of the probang may have to be abandoned, and other measures tried.

In obstinate cases of œsophageal obstruction in which there is danger of rupturing the œsophageal wall by the forcible passage of the probang, it has been shown by Lothian that the obstruction can often be readily removed if the instrument be passed after the animal has been lightly anæsthetized by chloroform.

An obstruction such as a portion of turnip may occasionally become lodged in the fauces, when it is usually capable of being removed manually.

THE DOG.—As vomiting can be readily induced in the dog, the injection of apomorphine in œsophageal obstruction may bring about speedy relief by emesis when the foreign body is such that it can be so expelled.

When the obstruction is smooth or is soft in consistence, it may be propelled by a probang into the stomach. A mouth speculum is inserted, and the probang, after lubrication, is passed carefully along the palate in the median line (the tongue being depressed by the forefinger of the left hand), over the epiglottis, and into the œsophagus. Care must be taken that it does not enter the trachea. When the obstruction is reached, gentle intermittent pressure is applied, but force must be avoided. If the obstruction cannot be dislodged by these means, recourse must be had to œsophagotomy.

THE STOMACH TUBE.

THE HORSE.—In the horse, two types of stomach-tube are employed. The single tube is passed by the nostril, while the double tube is introduced by way of the mouth.

The Single Tube.—This consists of a tube of firm rubber, 9 feet in length, $\frac{5}{8}$ inch in diameter, with a calibre of $\frac{3}{8}$ inch. One end is rounded or, preferably, smoothly buffed to a blunt point. The tube is marked at about 15 inches, and again at about 5½ feet from the rounded end, these being the approximate distances from the nostril to the pharynx and stomach respectively.

With the aid of an assistant, the head is extended and held in the median line. After lubrication with liquid paraffin the tube is passed along the floor of the naris, through the inferior meatus into the pharynx. At this point involuntary deglutitive efforts occur, and the tube is then passed 4 or 5 inches into the œsophagus. The operator should determine the presence of the tube in the œsophagus by palpation in the left jugular furrow before passing it further. Should the tube be introduced into the trachea, it will be found to pass with great facility, and the respired air can be detected by placing its end close to the ear.

The single stomach-tube is employed for the relief of gastric tympany, and as a means of administering large quantities of fluid.

The Double Tube.—The double stomach-tube is composed of two tubes of india-rubber, 10 feet long, and vulcanized together for a length of 7 feet. The tubes differ in size: the inlet tube measures $\frac{1}{4}$ inch and the outward tube $\frac{1}{2}$ inch in diameter. The tube is passed in a manner similar to that described for the probang, but as an alternative to fixing the jaws by means of a mouth speculum, a small strap may be drawn tightly round the nose just high enough to avoid interference with respiration, the tube being introduced into the mouth through an interdental space.

The double stomach-tube is employed in gastric irrigation.

CATTLE.—The stomach-tube employed for cattle is composed of stiff india-rubber, and has a diameter of about $\frac{5}{8}$ inch. It is passed in the same manner as the probang. The stomach-tube is commonly employed for the relief of tympany of the rumen, and for the administration of medicines, especially when these require to be given in a large volume of fluid.

PARACENTESIS.

By paracentesis is meant the surgical puncture of a cavity. All such operations must be performed under strict aseptic conditions, and the puncture wound should be treated surgically.

Paracentesis of the Intestine.

This is employed for the relief of acute intestinal tympany in the horse, and is performed by means of a trocar and cannula from 6 to 8 inches in length, the calibre of the cannula being from $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter. The site of operation is at a point equidistant from the last rib, the external angle of the ilium (*tuber coxæ*), and the transverse processes of the lumbar vertebræ. The instrument is introduced at this point and the trocar with-

drawn, leaving the cannula *in situ* until the gases have escaped. Should the gases fail to escape, and if this be not due to blockage of the cannula, the instrument may be again inserted within a few inches of the site of the first puncture, or, if the distension be bilateral, a puncture at the corresponding site on the other side may be made. When withdrawing the cannula, the trocar should be reinserted, and firm pressure exerted on the abdominal wall around the shield of the cannula. The puncture wound should be repeatedly observed for evidence of septic infection, which must be strictly controlled.

Paracentesis of the Rumen.

This minor operation is performed in the ox for the relief of tympany of the rumen. A large trocar and cannula (4 inches by $\frac{1}{4}$ to $\frac{3}{8}$ inch) is employed. The site of puncture is at the most prominent part of the distension on the left side—*i.e.*, at about a point equidistant from the last rib, the external angle of the ilium (*tuber coxæ*), and the transverse lumbar processes. Considerable force is necessary in order to penetrate the skin in cattle, and the operation is facilitated by previously incising the skin over the site of puncture. During the procedure the operator should stand as close to the fore-quarters of the animal as possible, in order to be out of reach of the kick which not infrequently follows the incision of the skin. On withdrawal of the trocar, it is advisable to press down upon the shield of the cannula, in order to prevent its displacement. It is often necessary to permit the cannula to remain *in situ* for some time after the gas has been evacuated, for the purpose of preventing a recurrence of tympany.

Paracentesis of the Abdomen.

THE HORSE AND OX.—A sterilized trocar measuring 2 inches long, with a cannula having a calibre of $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, is employed. The site of operation is shaved, and disinfected with tincture of iodine. When the cannula has entered the abdominal cavity, the trocar is withdrawn, and the fluid allowed to escape. The cannula is then withdrawn, and the site of the puncture is sealed with collodion.

THE DOG.—The puncture is made at a point midway between the umbilicus and the pubis, close to the *linea alba*. The fluid should be withdrawn slowly in order to avoid the danger of collapse, which may be occasioned by the sudden fall in blood-pressure consequent upon a large volume of fluid being quickly withdrawn. After withdrawal of the cannula, the puncture wound is sealed with collodion, and a broad bandage is then applied to the abdomen.

Paracentesis of the Thorax.

THE HORSE.—The indications for this operation will be found on p. 438. The site of operation is the sixth or seventh intercostal space, at a point about 3 inches above the level of the olecranon process. The operation is preferably performed on the right side. The puncture is made at the anterior margin of the rib in order to avoid injury to the intercostal artery. A sterilized trocar and cannula (about $\frac{1}{8}$ inch in diameter) is employed, and after disinfection of the site of puncture is inserted to a depth of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. The trocar is then withdrawn, and the cannula left *in situ* until the entire volume of fluid is evacuated. The puncture is then sealed with collodion, and the operation may be repeated as circumstances require.

THE DOG.—The animal should be placed in a sitting or standing posture. A fine aspirating needle is introduced in a somewhat forward direction at the posterior border of an intercostal space between the sixth and eighth ribs, preferably on the right side. Rigid aseptic precautions must be observed.

INTRATRACHEAL INJECTION.

Administration of medicinal agents by way of the trachea is chiefly confined to the injection of vermicides in the treatment of parasitic bronchitis in calves (p. 289).

An intratracheal syringe, fitted with a curved cannula, is employed. An assistant holds the animal's head upwards in order to maintain the neck in the median line, and to render the trachea tense. A small incision is made in the skin to expose the trachea in the upper third of the neck. The cannula is inserted at an inter-annular space with the point of the instrument directed downwards. The syringe containing the dose (see p. 289) is then attached to the cannula, and its contents slowly injected.

ARTIFICIAL RESPIRATION.

The need for the practice of artificial respiration in the domestic animals usually arises as the result of threatened respiratory collapse under general anæsthesia.

THE HORSE.—The tongue should be drawn well forward, and the animal's head held for a moment in such a position that any fluid which has accumulated in the pharyngeal region can escape. The operator should press his foot into the horse's abdomen firmly and deeply, but not roughly, at first every three seconds, and then more frequently if no success be obtained. Simultaneously an assistant should extend the head, allow fresh air, and

remove the hobbles. An intravenous injection of adrenaline is then given.

THE DOG.—In apparently hopeless cases, efforts should be maintained even when the cardiac impulse is no longer perceptible. The animal is placed on his right side, with the head at a level lower than that of the body. The thoracic cavity is alternately compressed, and allowed to expand, and this action is continued until normal respiration is restored. In the dog, the injection of nikethamide (p. 203) has been found of value in stimulating respiration.

In applying measures of forced artificial respiration, it is to be realized that the procedure not only introduces fresh air into the lungs, but tends to flush out the residual carbon dioxide. Carbon dioxide is the normal respiratory stimulant, and if artificial respiration be carried out to excess, the carbon dioxide may be flushed out to such an extent that the physiological stimulus to the respiratory centre may be reduced to a concentration below that which is effective. During the course of artificial respiration, it is good practice to allow the animal to breathe air to which carbon dioxide has been added to a concentration of 5 to 8 per cent., and, even after spontaneous respiration has commenced, the addition of carbon dioxide to the inspired air, by stimulating the respiratory centre, hastens recovery.

Carbon dioxide can be conveniently obtained from one of the several portable appliances now available; in these the gas is compressed in small bulbs, and is conveyed through a rubber tube leading to a funnel, from which the animal inspires. In the field, the funnel may be conveniently replaced by a folded towel wrapped lightly round the animal's muffle.

CATHETERIZATION.

Catheterization should be performed under as strict aseptic conditions as are practicable.

THE HORSE.—Difficulty is often experienced in withdrawing the penis from the prepuce, as in many instances the animal retracts the organ as it is being grasped by the operator. Considerable patience is required, and in some cases the application of a twitch to the animal's upper lip succeeds in distracting his attention so that the penis can be exposed. No force should be employed, gentle traction only being necessary. The catheter, which should be lubricated with sterilized liquid paraffin, is passed carefully into the urethra, slow steady pressure being applied.

No obstruction to the passage of the catheter is felt until the instrument enters the bend of the urethra at the ischial arch. If necessary, an assistant should then insert his finger in the rectum and direct the end of the catheter forwards towards the bladder, while the operator, by gentle pressure, pushes the instrument onwards and retracts the stilette for a few inches. When the catheter enters the bladder, the stilette is fully withdrawn, and the urine then escapes.

THE MARE.—A short catheter composed of gum elastic is employed. The left hand of the operator is inserted into the vagina, and the location of the urethral orifice on the vaginal floor is determined with the index finger. The catheter is then introduced and guided into the urethra. The urethra of the mare is so dilatable that in cases of emergency two fingers can be introduced into the meatus, which manipulation is often sufficient to produce urination.

THE BULL AND OX.—Because of the sigmoid flexure in the urethra, the catheter cannot be introduced farther than this point, so that in the case of retention of urine it is necessary to make a longitudinal incision in the urethra at the ischial arch and insert the catheter by this means.

THE COW.—The procedure is similar to that advised for the mare, but considerable difficulty may be experienced by the student because of the presence of the suburethral diverticulum, which opens behind the meatus urinarius, from which it is separated by a thin membranous flange. In passing the catheter, the index finger of the left hand is introduced into the meatus, and the catheter passed below the finger, which acts as a guide. In this way the catheter enters the diverticulum; it is then slowly withdrawn, the point raised, and gently pressed forward into the urethra.

THE RAM.—The urethra describes a sigmoid curve similar to that in the bull, so that simple catheterization is not practicable. Urethrotomy in the ram presents considerable difficulty, but if, as is commonly the case, the obstruction be due to a calculus situated at the base of the free vermiform portion of the urethra (processus urethræ), this may be amputated, when immediate relief is afforded.

THE DOG.—In the dog a gum elastic catheter is employed, the length and diameter of which is determined by the size of the animal. The dog is placed on his left side, and the right hind-leg is drawn forward and upward by an assistant. The glans penis is exposed, and the catheter, after lubrication, carefully introduced into the meatus, and gently passed along the urethra. As it enters that portion of urethra which passes through the

groove in the os penis, a slight obstruction is encountered which, however, is easily overcome. When the ischial arch is reached, another slight obstruction is met with, and the stilette should be withdrawn for a short distance. The instrument can now be passed into the bladder without difficulty. The stilette is fully withdrawn, and the urine escapes.

THE BITCH.—In small bitches considerable difficulty is often experienced in passing the catheter. The catheter employed is composed of gum elastic, the diameter varying with the size of the animal. Jakob advises the operator to place his thumb and forefinger on the external vulvar region, drawing the vulva backwards to a moderate extent, and then to introduce the catheter by way of the upper vulvar commissure. By exerting a moderate degree of pressure with the fingers externally on the vulvo-vaginal region (which in small bitches is not more than $1\frac{3}{8}$ inches distant from the vulvar lips), the catheter is generally prevented from missing the opening of the urethra. In the larger breeds the animal should be placed in the standing posture, and the catheter is guided by the forefinger of the left hand into the urethral orifice.

THE MALE CAT.—The male cat is a common subject of urethral obstruction, due to calculi or to the presence of an accumulation of sabulous material. Gray employs a fine, straight, metal catheter, about 5 or 6 inches in length. The diameter varies with the size of the animal. Gray advises that an assistant hold the two fore-legs with his left hand, and the right hind-leg with his right hand, the left, or under hind-leg, being free.

The prepuce is retracted, and the catheter is passed into the meatus until it reaches the floor of the pelvis, when it meets with some resistance. The catheter is then gently directed posteriorly until it is in line with the pelvic floor. It is then passed into the bladder. If the obstruction be due to a collection of sabulous matter, and if this be confined to the region of the meatus, it may be extruded by gentle but firm pressure of the glans penis between the thumb and index fingers.

UTERINE IRRIGATION IN THE MARE AND COW.

Uterine irrigation is principally employed in the treatment of septic metritis, and is most satisfactorily performed by means of a tube similar to the double stomach-tube described on p. 471. A continuous-flow injection pump is attached to the inlet-tube, and after the completion of irrigation the residual fluid should be entirely withdrawn by siphonage through the exit-tube.

The antiseptic solution employed should not be such as will occasion irritation of the uterine mucous membrane.

Uterine irrigation may with advantage be followed by the insertion of an antiseptic pessary.

EPIDURAL ANÆSTHESIA.

The practicability of spinal anæsthesia in veterinary practice has recently received considerable attention. Novocaine (1 to 2 per cent. in physiological salt solution) is the anæsthetic usually employed.

THE HORSE.—The site of injection is between the first and second coccygeal vertebræ; the needle (Nos. 16 to 18, Imperial Standard Gauge), which should be 2 inches in length, is pointed obliquely forward, and inserted in the centre of the intra-vertebral depression at an angle of about 45 degrees.

Frank advises for dystokia, prolapsus uteri, and other obstetrical conditions, 20 to 40 c.c. of a 1 per cent. solution of novocaine, or one-half these amounts of a 2 per cent. solution may be used. For amputation of the tail, 10 to 15 c.c. of a 1 per cent. solution are employed. In operations for hernia and castration, 20 to 40 c.c. of a 2 per cent. solution are required.

Anæsthesia is complete within ten to fifteen minutes and continues for thirty minutes to two hours.

CATTLE.—The site of injection is between the first and second coccygeal vertebræ, or at the sacro-coccygeal articulation. The needle (No. 16 gauge) is introduced in a manner similar to that described for the horse. Of a 1 per cent. solution of novocaine, 20 to 40 c.c. are employed in the replacement of prolapse of the rectum, vagina, or uterus, in torsion of the uterus, and for the removal of retained placenta. The retractor penis muscle of the bull readily relaxes under epidural anæsthesia, and so permits the penis to be exposed and examined with facility. For amputation of the mamma, Frank advises 40 c.c. of a 3 per cent. solution of novocaine.

THE DOG.—The site of injection is between the last sacral vertebræ; the needle (Nos. 18 to 25, Imperial Standard Gauge) is inserted at an angle somewhat less than 45 degrees from the perpendicular. A 2 per cent. solution of novocaine is employed in doses of 1 c.c. for each 5 pounds of body weight, for such operations as ovariectomy, Cæsarian section, and hind-limb amputation. For amputation of the tail, $\frac{1}{2}$ c.c. of novocaine for each 5 pounds body weight suffices.

For fuller technical details, the reader is referred to textbooks on Veterinary Surgery.

VENESECTION, PHLEBOTOMY OR BLOOD-LETTING.

The amount of blood usually taken from the horse varies from 6 to 8 pints, and the requisite amount is to be determined by the effect produced on the pulse. The vessel selected is the jugular vein. The horse's head is raised, and the vein is distended by means of pressure applied below the site of operation, at a point about the junction of the upper and middle third of the neck. The edge of the fleam is brought into contact with the skin at this point, and the back of the instrument is struck a smart tap with the 'blood-stick,' sufficient to cause the blade to cut through the skin and the vein, when the blood issues in a full stream. When sufficient blood has been taken, the edges of the wound in the skin are brought together and secured by a pin, around which a piece of aseptic suture thread is wound. Strict surgical cleanliness must be observed.

When it is considered desirable to practise phlebotomy, this is now usually performed by means of venous puncture with a hollow needle of wide calibre.

INTRAMAMMARY INJECTION OF ANTISEPTIC SOLUTIONS.

The intramammary infusion or injection of 1 in 10,000 aqueous solutions of acriflavine has been used in the treatment of sub-acute and chronic streptococcal mastitis (see p. 211), but is only employed just before or during a non-lactating period.

Strict aseptic precautions must be observed throughout the procedure.

The solution is prepared with sterile distilled water and should be introduced at a temperature of approximately 100° F. The amount required varies from 400 to 800 c.c. (100 to 200 c.c. being introduced into each quarter). The infusion may be effected by means of a 'gravity apparatus' consisting of a container attached by a piece of rubber tubing to a 'teat tube,' or the solution may be injected. For this purpose the solution is placed in a flask provided with a tightly fitting rubber stopper through which there pass two tubes of either glass or metal: the shorter, terminating just within the flask, is connected to a rubber hand bellows; the longer, which reaches to nearly the bottom of the flask, is connected to the teat tube by rubber tubing. On introducing air by the bellows the solution is forced through the teat tube. Whichever apparatus is employed, the whole must be effectively sterilized immediately prior to use.

The udder and teats are thoroughly washed and dried; any milk in the udder is then stripped out. The ends of the teats are

sterilized with a solution consisting of 1 in 1,000 of biniodide or of perchloride of mercury in alcohol (90 per cent.). The teat tube is inserted and the injection made until the tension in the quarter is approximately equal to that of an udder turgid with milk. During the injection, the quarter should be massaged and the massage continued for a few minutes to ensure diffusion of the solution throughout the gland. The process is repeated in each quarter of the udder.

In lactating animals the acriflavine solution should be 'stripped out' after a period of five minutes, and the stripping process repeated several times during the day. In non-lactating animals the solution may be allowed to remain in the gland for twenty-four hours.

APPENDIX I

FORMULÆ*

The following formulæ are to be regarded as merely representative.

ALTERATIVES.

Horses.

ALTERATIVE MIXTURES.

- (1) R Hydrarg. Iod. Rubr. ̄i.
 Pot. Iod. ̄i.
 Aquam ad ̄xii.
 Ft. M. Sig.: Give half a wineglassful three times daily
 in the food.
- (2) R Liq. Arsen. ̄x.
 Ferr. Sulph. ̄v.
 Tinct. Gent. Co. ̄v.
 Aquam ad O.i.
 Ft. M. Sig.: Give a wineglassful twice daily in the food.

ALTERATIVE POWDERS.

- (1) R Sulphur. Sub. ̄iii.
 Antim. et Pot. Tart. ̄i.ss.
 Sod. Bicarb. ̄iv.
 Pulv. Anis. ̄iii.
 M. Div. in pulv. xii. Sig.: Give one powder twice daily
 in the food.
- (2) R Arsen. Trioxid ̄i.
 Ferr. Sulph. Exsic. ̄i.ss.
 Sod. Bicarb. ̄iv.
 Pulv. Anis. ̄iii.
 M. Div. in pulv. xii. Sig.: Give one powder twice daily
 in the food.
- (3) R P. Mag. Sulph. ̄vi.
 P. Sulphur. Sub. ̄ii.
 P. Sod. Bicarb. ̄ii.
 M. Div. in pulv. vi. Sig.: Give one powder twice daily
 in the food.

* N.B.—In the formulæ for dogs, the doses indicated throughout the text are those suitable for a dog from the size of a fox-terrier upwards. For smaller animals, and for the toy breeds, from one-half to one-quarter of these doses is sufficient. The doses must also be modified according to the circumstances of the case.

Cattle.

ALTERATIVE POWDERS.

- R P. Mag. Sulph. ʒvi.
 P. Sulphur. Sub. ʒiii.
 P. Sod. Bicarb. ʒiii.
 P. Ferr. Sulph. Exsic. ʒi.ss.
 P. Anis. ʒiii.
- M. Div. in pulv. vi. Sig.: Give one powder twice daily
 in the food.

Dogs.

ALTERATIVE MIXTURES.

- (1) R Liquoris Arsenicalis ʒi.
 Syrupus ʒi.ss.
 Aquam ad ʒvi.
- Ft. M. Sig.: Give from a teaspoonful to a tablespoonful
 (according to the size of dog) three times daily after
 feeding.
- (2) R Liq. Arsen. et Hydrarg. Iod. ʒi.
 Syrupus ʒii.
 Aquam ad ʒvi.
- Ft. M. Sig.: Give from a teaspoonful to a tablespoonful
 twice daily after feeding.
- (3) R Pot. Iod. grs. xxx.
 Pot. Bicarb. ʒi.
 Tinct. Cinchon. Co. ʒss.
 Syrupus ʒi.
 Aquam ad ʒiv.
- Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful
 three times daily.

ALTERATIVE POWDERS.

- (1) R Arsen. Trioxid. gr. ʒi.
 Mag. Sulph. grs. x.
 Sod. Bicarb. grs. v.
- M. Ft. pulv. i. Mitte xii. Sig.: Give one twice daily
 in the food.
- (2) R Sulphur. Præcip. grs. v. to grs. x.
 Sod. Bicarb. grs. v. to grs. x.
 Mag. Sulph. grs. x. to grs. xx.
- M. Ft. pulv. i. Mitte xii. Sig.: Give one twice daily
 in the food.
- (3) R Sulphur. Præcip. grs. v. to grs. x.
 Pot. Tart. Acid. grs. v. to grs. x.
- M. Ft. pulv. i. Mitte xii. Sig.: Give one twice daily
 in the food.

EXPECTORANTS.

Horses.

EXPECTORANT ELECTUARY.

R	P. Glycyrrh.	..	..	..	..	℥ss.
	P. Anis.	..	..	..	..	℥ss.
	Pot. Chlorat.	..	..	..	..	℥i.
	Theriac.	..	..	..	..	℥iv.
	Glycer.	..	..	..	..	℥iv.

M. Ft. electuarium. Sig.: Give one tablespoonful three times daily.

EXPECTORANT MIXTURE FOR CHRONIC COUGH.

R	Ext. Bellad. Liq.	..	..	..	..	℥v.
	Pot. Iod.	..	..	..	..	℥x.
	Liq. Arsen.	..	..	..	..	℥x.
	Glycer.	..	..	..	..	℥iv.
	Aquam	..	..	..	..	ad O.i.

Ft. M. Sig.: Give a wineglassful twice daily in the food or drinking water.

POWDERS FOR COUGH.

R	Pot. Chlorat.	..	..	..	..	℥vi.
	P. Glycyrrh.	..	..	..	..	℥i.ss.
	P. Anis.	..	..	..	..	℥vi.

M. Div. in pulv. vi. Sig.: Give one twice a day in the food.

FOR CHRONIC COUGH.

R	Arsen. Trioxid.	..	..	..	..	℥ss.
	Antim. et Pot. Tart.	..	..	..	..	℥vi.
	P. Anis.	..	..	..	..	℥ii.

M. Div. in pulv. vi. Sig.: Give one every night in the food.

Dogs.

EXPECTORANT MIXTURES.

(1)	R	Pot. Cit.	..	..	..	grs. lxxx.
		Tinct. Ipecac.	..	..	..	℥lxxx.
		Liq. Ammon. Acet. Dil.	..	..	..	℥i.
		Aquam	..	..	..	ad ℥iv.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful every four hours.

(2)	R	Tinct. Ipecac.	..	..	..	℥ii.
		Syr. Scill.	..	..	..	℥iv.
		Aquam	..	..	..	ad ℥iv.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful every four hours.

- (3) R Ammon. Carb. grs. xx.
 Tinct. Scill. ʒi.
 Sp. Chlorof. ʒi.
 Aquam ad ʒiv.
 Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful
 every four hours.

EXPECTORANT INHALATION.

- R Ol. Eucalyp. ʒii.
 Mag. Carb. Lev. ʒi.
 Aquam ad ʒvi.
 M. Sig.: Mix a teaspoonful in a pint of water at 140° F. for each
 inhalation.

SEDATIVES AND ANODYNES.

Horses.

SEDATIVE BOLUS.

- R Chloral. Hydr. ʒi.
 Excipient. q.s.
 Ft. bol. ii. Sig.: Give both balls at once. Repeat as often
 as is necessary at intervals of two hours.

ANODYNE DRAUGHTS.

- (1) R Ext. Cannab. Indic. ʒss. to ʒi.
 Glycerin. ʒii.
 Aquam ad O.i.
 M. Ft. haust. Sig.: Give at once.
 (2) R Chloral. Hydr. ʒss.
 Mucil. Acac. ʒiv.
 Aquam ad O.i.
 M. Ft. haust. Sig.: Give at once.

Horses and Cattle.

ANODYNE DRAUGHTS.

- (1) R Chloral. Hydr. ʒi.
 Sp. Camphor. ʒi.
 Aquam ad O.i.
 M. Ft. haust. Sig.: Mix with half a pint of treacle water and
 give as one dose. Repeat in two hours if necessary.
 (2) R Tinct. Chlorof. et Morph. Co. ʒi. to ʒii.
 Ol. Lini ad O.i.
 M. Ft. haust. Sig.: Give at once.
 (3) R Chloral. Hydr. ʒi.
 Pot. Brom. ʒi.
 Aquæ O.i.
 M. Ft. haust. Sig.: Mix with half a pint of treacle water and
 give as one dose. Repeat in two hours if necessary.

SEDATIVE MIXTURE.

R	Chloral. Hydr.	..	..	..	3ii.ss.
	Pot. Brom.	..	..	..	3iii.
	Aquam	..	..	..	ad O.i.

Ft. M. Sig.: Give two wineglassfuls every four hours in a pint of linseed-tea as required.

Dogs.

SEDATIVE MIXTURES.

(1)	R	Pot. Brom.	..	..	..	3ii.
		Aquam	..	..	..	ad 3iv.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful in water every three or four hours as required.

(2)	R	Phenobarbiton	gr. i.
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Ft. tabell. Mitte xii. Sig.: One tablet to be given every four hours.

(3)	R	Ammon. Brom.	}	āā 3i.ss.
		Sod. Brom.				
		Pot. Brom.				
		Syrup.	..	..	..	q.s.
		Aquam	..	..	..	ad 3iv.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful every three or four hours as required.

GASTRIC SEDATIVES.

Horses.

ELECTUARY.

R	Ext. Bellad. Liq.	..	..	..	3ss.
	Pulv. Glycyrrh.	..	..	..	3iii.
	Theriac.	..	..	..	3viii.

M. Ft. electuarius. Sig.: Give a tablespoonful every four hours.

MIXTURES.

(1)	R	Ext. Bellad. Liq.	..	..	..	3ii.ss.
		Mag. Carb. Pond.	..	..	..	3ii.ss.
		Acid. Hydrocyan. Dil.	..	..	..	3iii.
		Aquam	..	..	..	ad O.i.

Ft. M. Sig.: Give two wineglassfuls every four hours in a pint of linseed-tea or in the drinking water.

If Pain be a Prominent Symptom.

(2)	R	Tinct. Chlorof. et Morph. Co.	..	..	..	3iii.
		Sp. Chlorof.	..	..	..	3v.
		Aquam	..	..	..	ad O.i.

Ft. M. Sig.: Give two wineglassfuls every four hours in a pint of linseed-tea.

Dogs.

MIXTURE IN DYSPEPSIA ACCOMPANIED BY HYPERCHLORHYDRIA AND FLATULENCE AFTER FEEDING.

R	Tinct. Rhei Co.	..	..	..	℥vi.
	Mag. Carb. Lev.	..	..	..	℥i.
	Sp. Ammon. Aromat.	..	..	..	℥iii.
	Aq. Ment. Pip. Dest.	..	..	..	ad ℥vi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful as required.

GASTRIC SEDATIVE POWDERS.

R	P. Bism. Carb.	}	āā grs. xxx.
	P. Sod. Bic.				
	P. Mag. Carb. Pond.				

M. Div. in pulv. vi. Sig.: Give one on the tongue every four hours.

GASTRIC SEDATIVE MIXTURE.

R	Liq. Bism. et Ammon. Cit.	..	..	℥i.ss.
	Acid. Hydrocyan. Dil.	..	..	℥xviii.
	Mag. Carb. Pond.	..	..	℥ii.
	Aquam ..	..	..	ad ℥vi.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful every three or four hours.

If Pain be a Prominent Symptom.

Tinct. Opii	..	..	..	℥ii.
Sp. Chloroform.	..	..	..	℥i.
Aq. Ment. Pip. Dest.	..	..	..	ad ℥vi.

Ft. M. Sig.: Give from two teaspoonfuls to a tablespoonful every three or four hours.

In Case of Persistent Vomiting.

R	Chlorbutol.	..	..	..	grs. v. to grs. x.
Ft. pulv. i.	Mitte iii.	Sig.: Place on the back of the tongue. Repeat in two hours if necessary.			

NOTE.—In toy dogs and in cats the dose of chlorbutol should not exceed 2 to 4 grains.

STOMACHICS.

Horses.

MIXTURE.

R	Tinct. Nuc. Vom.	..	..	..	℥ii.ss.
	Acid. Hydrochlor. Dil.	..	..	..	℥x.
	Tinct. Gent. Co.	..	..	..	℥v.
	Aquam ..	..	..	..	ad O.i.

Ft. M. Sig.: Give two wineglassfuls three times a day in a pint of ale.

POWDER.

R	P. Sod. Bicarb.	..	..	..	℥iv.
	P. Sod. Chlorid.	..	..	..	℥iii.
	P. Nuc. Vom.	..	..	..	℥i.

Ft. pulv. i. Mitte xii. Sig.: Give one powder twice daily in the food.

Cattle.

POWDERS.

(1)	R	Pulv. Ammon. Carb.	..	..	..	℥iii.
		Pulv. Nuc. Vom.	..	..	..	℥i.ss.
		Pulv. Sinap.	}	..	..	āā ℥vi.
		Pulv. Gentian.				
		Pulv. Zingib.				

M. Div. in pulv. vi. Sig.: Give one powder three times daily in a pint of warm ale.

(2)	R	Pulv. Sod. Bicarb.	}	..	..	..	āā ℥v.
		Pulv. Sod. Chlorid.					
		Pulv. Nuc. Vom.	..	..	..	..	℥vi.
		Pulv. Gentian.	..	..	..	..	℥i.ss.

M. Div. in pulv. vi. Sig.: Give one powder twice a day mixed with treacle in the form of electuary.

STOMACHIC POWDER FOR CALVES.

R	Pulv. Rhei Co.	℥ii. to ℥iv.
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M. Ft. pulv. i. Mitte vi. Sig.: Give in $\frac{1}{2}$ pint of warm milk. Repeat once or twice at intervals of twenty-four hours.

Dogs.

ACID STOMACHIC MIXTURE.

℞	Acid. Hydrochlor. Dil.	..	..	..	℥i.
	Tinct. Nuc. Vom.	..	..	..	℥ss.
	Syrupus ..	..	..	..	℥i.
	Aquam ..	..	..	..	ad ℥vi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful three times daily.

ALKALINE STOMACHIC MIXTURE.

R	Sod. Bicarb.	..	..	..	℥ii.
	Tinct. Nuc. Vom.	..	..	..	℥ss.
	Tinct. Gent. Co.	..	..	..	℥iv.
	Syrupus ..	..	..	..	℥i.
	Aq. Ment. Pip. Dest.	..	..	..	ad ℥vi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful three times daily.

ALKALINE STOMACHIC AND LAXATIVE MIXTURE.

R	Bism. Carb.	}	..	..	..	āā	ʒii.	grs. xl.
	Sod. Bicarb.							
	Mag. Carb. Lev.							
	Mucil. Trag.	..	..	..	..	ʒii.		
	Aquam	..	..	..	..	ad	ʒiv.	

Ft. M. Sig.: Give from one to two teaspoonfuls twice or thrice daily.

ANTISPASMODICS AND ANTIZYMOLOGICS.

Horses.

DRAUGHTS.

(1)	R	Ol. Terebinth.	..	..	..	..	ʒii.
		Æther	..	..	..	..	ʒi.
		Ol. Lini	..	..	..	..	O.i.

Ft. haust. Sig.: Give at once.

(2)	R	Chloral. Hydr.	..	..	..	..	ʒi.
		Aquæ	..	..	..	..	ʒiv.
		Ol. Lini	..	..	..	..	O.i.

Ft. haust. Sig.: To be given if pain be severe.

(3)	R	Ol. Terebinth.	..	..	..	..	ʒii.
		Liq. Ammon. Dil.	..	..	..	..	ʒiii.
		Phenol. Liq.	..	..	..	..	ʒss.
		Ol. Lini	..	..	..	..	O.i.ss.

Ft. haust. Sig.: Give at once.

DRAUGHT IN ACUTE GASTRIC TYMPANY.

R	Tereben.	..	..	..	..	ʒii.
	Phenol. Liq.	..	..	..	..	ʒi.
	Ol. Lini	..	..	..	..	O.i.

M. Ft. haust. Sig.: Administer immediately after relieving the acute tympany by stomach tube.

DRAUGHT IN COLIC WITH IMPACTION OF THE COLON.

R	Aloe Barb.	..	..	..	..	ʒv.
	Aquam Ferv.	..	..	..	..	q.s.
	Ol. Terebinth.	..	..	..	..	ʒii.
	Chloral. Hydr.	..	..	..	..	ʒi.
	Ol. Lini	..	..	..	..	O.i.

Ft. haust. [Dissolve the aloes and the chloral hydrate in the hot water, and shake up well with the oil of turpentine and linseed-oil.]

Cattle.

DRAUGHTS IN TYMPANITIS OF THE RUMEN.

(1)	R	Liq. Formaldehyd.	..	..	..	ʒvi.
		Tinct. Zingib. Mit.	..	..	..	ʒi.
		Aquam	..	..	..	ad ʒviii.

M. Sig.: Mix with 1 gallon of approximately 1 per cent. saline solution and administer by stomach-tube. Repeat as required.

- (2) R Ol. Terebinth. ℥iv.
 Liq. Ammon. Dil. ℥i.
 Liq. Calcis }
 Ol. Lini) āā O.i.
 M. Ft. haust. Sig.: Give at once.

ANTIZYMOTIC AND ASTRINGENT DRAUGHT FOR CALVES

- R Tereben. ℥iii.
 Tinct. Chlorof. et Morph. Co. ℥i.
 Mucil. Acac. q.s.
 Aquam ad ℥ii.
 M. Ft. haust. Sig.: Give in $\frac{1}{2}$ pint of boiled milk to which has been added a wineglassful of brandy. Repeat in six hours if necessary.

Dogs.

APERIENT AND ANODYNE DRAUGHT.

- R Tinct. Rhei Co. ℥ss. to ℥i.
 Tinct. Chlorof. et Morph. Co. ℥x. to ℥xv.
 Ol. Ricin. ℥ii. to ℥iv.
 Aq. Menth. Pip. Dest. ad ℥i. to ℥ii.
 M. Ft. haust. Sig.: Give at once.

APERIENT AND ANODYNE MIXTURE FOR PUPPIES.

- R Tinct. Rhei Co. ℥ii.
 Sp. Ammon. Aromat. ℥ss.
 Sp. Chlorof. ℥ss.
 Aq. Menth. Pip. Dest. ad ℥ii.
 Ft. M. Sig.: Give from half a teaspoonful to two teaspoonfuls every hour until relieved.

ANTIPYRETICS AND DIURETICS.

Horses.

ANTIPYRETIC ELECTUARIES.

- (1) R Phenacetin ℥i.
 Theriac. ℥iv.
 M. Ft. electuar. Sig.: Give a tablespoonful every four hours on the tongue.
 (2) R Sod. Salicyl. ℥ii.
 Sod. Bicarb. ℥ii.
 Theriac. ℥iv.
 M. Ft. electuar. Sig.: Give a tablespoonful every four hours on the tongue.

ANTIPYRETIC AND DIURETIC MIXTURES.

- (1) R Pot. Acet. ℥ii.ss.
 Tinct. Digit. ℥x.
 Sp. Aether. Nitros. ℥v.
 Aquam ad O.i.
 Ft. M. Sig.: Give two wineglassfuls every four hours in a pint of linseed-tea.

- (2) R Pot. Acet. ʒii.ss.
 Liq. Ammonii Acet. Fort. ʒv.
 Aquam ad O.i.

Ft. M. Sig.: Give two wineglassfuls every four hours
 in a pint of linseed-tea.

ANTIPYRETIC AND DIURETIC POWDERS.

- (1) R P. Mag. Sulph. ʒxii.
 P. Pot. Nit. ʒii.

M. Div. in pulv. vi. Sig.: Give one twice a day
 dissolved in the drinking water.

- (2) R P. Sod. Bicarb. ʒii.
 P. Pot. Acet. ʒiii.

M. Div. in pulv. vi. Sig.: Give one every six
 hours in the drinking water.

ANTIPYRETIC BOLUS.

- R Quinin. Sulph. ʒi. to ʒi.ss.
 Ammon. Carb. ʒii.
 Excipient. q.s.

Ft. bol. i. Mitte vi. Sig.: Give one three times daily.

Dogs.

ANTIPYRETIC MIXTURE.

- R Sod. Salicyl. ʒi.
 Syr. ʒss.
 Aquam ad ʒiv.

Ft. M. Sig.: Give from two teaspoonfuls to a table-
 spoonful every two hours.

ANTIPYRETIC AND DIURETIC MIXTURE.

- R Pot. Acet. ʒiii.
 Liq. Ammon. Acet. Dil. ʒii.
 Syrup. q.s.
 Aquam ad ʒiv.

Ft. M. Sig.: Give from two teaspoonfuls to a table-
 spoonful three times daily.

DIURETIC MIXTURE IN ASCITES ASSOCIATED WITH CARDIAC DISABILITY.

- R Tinct. Digit. ℥lxxv.
 Theobrom. et Sod. Salicyl. ʒii.
 Syr. ʒi.
 Aquam. ad ʒiv.

Ft. M. Sig.: Give from two teaspoonfuls to a table-
 spoonful three times daily.

ANTHELMINTICS.

Horses.

ANTHELMINTIC DRAUGHT.

R	Ol. Terebinth.	℥ii.
	Spt. Æth. Nit.	℥ii.
	Ol. Lini	O.i.

Ft. haust. Sig.: Give at one dose. [The horse should be prepared by feeding on soft food for two days previously.]

ANTHELMINTIC POWDERS.

(1)	R	Pulv. Antim. et Pot. Tart.	℥i.ss.
		Pulv. Ferr. Sulph. Exsicc.	℥i.ss.
		Pulv. Gentian.	℥ii.
		Pulv. Anis.	℥ii.

M. Div. in pulv. xii. Sig.: Give one twice daily in the food. When all have been taken, administer an anthelmintic draught.

(2)	R	Phenothiazine	℥i.
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Ft. pulv. i. Sig.: Give the powder well mixed in a bran mash or feed of bruised corn.

FOR STRONGYLOSIS IN FOALS.

R	Ol. Chenopod.	℥i.
	Ol. Terebinth.	℥ii.
	Chloroform	℥ss.
	Ol. Lini	ad. ℥viii.

Ft. Haust. Sig.: Give after fasting for 12 or more hours.

Sheep.

FOR PARASITIC GASTRITIS IN SHEEP.

(1)	R	Cupr. Sulph.	℥i.ss.
		Nicotin. Sulph. Sol ⁿ . (40 per cent.)	℥i.ss.
		Aquam.	ad C.ss.

Ft. M. Sig.: Give $3\frac{1}{2}$ to 4 ounces to each sheep or 1 to 2 ounces to each lamb. It is advisable to repeat the treatment at monthly intervals throughout the period the sheep are grazed on worm-infested pasture.

(2)	R	Phenothiazine	℥iv.
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Ft. pulv. i. Mitte xxx. Sig.: Give one powder suspended in two or three ounces of mucilaginous fluid.

Dogs.

FOR ROUND-WORM INFESTATION OF PUPPIES.

R	Ol. Chenopod.	..	..	..	..	℥xvi.
	Chloroform.	..	..	..	..	℥ss.
	Ol. Ricin.	..	..	..	..	ad ℥ii.

Ft. M. Sig.: Give one to two teaspoonfuls according to the breed and age of the puppy. After two hours give an equal quantity of castor-oil. (For small toy breeds give a quarter to one-half these doses.)

FOR ASCARIS INFESTATION OF ADULT DOGS.

R	Ol. Chenopod.	..	..	..	..	℥i.
	Ol. Terebinth.	..	..	..	..	℥i.
	Chloroform.	..	..	..	..	℥ii.
	Ol. Ricin.	..	..	..	..	℥xiv.

Ft. M. Sig.: Give from $\frac{1}{2}$ drachm to 2 drachms in an equal amount of castor-oil.

FOR TAPE-WORM INFESTATION OF ADULT DOGS.

R	Arecolin. Hydrobrom.	..	..	..	gr. $\frac{1}{2}$.
	Chlorbutol.	..	..	..	grs. ii.ss.

Ft. pulv. i. Sig.: Give in a gelatin capsule after fasting over night.

CATHARTICS.

Horses.

PURGATIVE BOLUSES.

(1)	R	Aloe Barb.	..	..	..	℥v.
		Ext. Bellad. Sicc.	..	..	..	grs. xv.
		Pulv. Gentian.	..	..	..	℥i.
		Ol. Menth. Pip.	..	..	..	℥xx.
		Excipient.	..	..	..	q.s.

Ft. bol. i.

(2)	R	Aloe Barb.	..	..	..	℥vi.
		Hydrarg. Subchlor.	..	..	..	℥ss.
		Pulv. Gentian.	..	..	..	℥i.ss.
		Ol. Menth. Pip.	..	..	..	℥xx.
		Excipient.	..	..	..	q.s.

Ft. bol. i.

FORMULA FOR ALOETIC MASS (*Lothian*).

R	Aloe Barb.	..	..	..	..	lb. iii.
	Pulv. Zingib.	..	..	..	..	℥iii.
	Ol. Oliv.	..	..	..	..	℥i.
	Alcohol (95 per cent.)	..	..	..	..	℥viii.

[The aloes is reduced to a coarse powder and placed in a water bath, the temperature of the bath being kept moderate. The alcohol is added and the ingredients are stirred until the aloes is dissolved, when the ginger is added and finally the oil. ℥x. of this mass contains ℥viii. of aloes.]

PURGATIVE DRAUGHT.

R	Aloe Barb.	3vi.
	Aquæ Ferv.	O.i.

When dissolved add:

Tinct. Zingib. Mit.	3i.
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Ft. haust.

LAXATIVE POWDERS.

R	P. Sod. Sulph. Exsicc.	3iv.ss.
	P. Sod. Chlor.	3ii.ss.
	P. Sod. Bicarb.	3iv.ss.

M. Div. in pulv. vi. Sig.: Give one twice daily in the food or drinking water.

Cattle.

PURGATIVE DRAUGHTS.

(1)	R	Mag. Sulph.	..	..	..	3viii. to 3xii.
		Tinct. Zingib. Fort.	..	..	..	3ii.
		Theriac.	..	..	..	lb. i.
		Aquæ	..	..	..	O.iii.

Ft. haust. Sig.: Give at once.

(2)	R	Mag. Sulph. }	..	..	..	3vi.
		Sod. Chlor. }	..	..	..	3vi.
		Tinct. Zingib. Fort.	..	..	..	3ii.
		Theriac.	..	..	..	lb. i.
		Aquæ	..	..	..	O.iii.

Ft. haust.

(3)	R	Mag. Sulph.	..	..	..	3viii.
		Aloe Barb.	..	..	..	3i.
		Tinct. Zingib. Fort.	..	..	..	3ii.
		Theriac.	..	..	..	lb. i.
		Aquæ Ferv.	..	..	..	O.ii.

Ft. haust.

Sheep.

PURGATIVE.

For Large Sheep.

R	Pulv. Mag. Sulph.	..	..	..	3iii.
	Tinct. Gentian. Co.	..	..	..	3ii.
	Tinct. Zingib. Fort.	..	..	..	3ss.

Ft. pulv. i. Sig.: Mix with $\frac{1}{2}$ pint of linseed mucilage, and give as a draught.

Swine.

PURGATIVES.

(1)	R	Pulv. Jalap. Co.	..	..	..	3i. to 3iii.
		Hydrarg. Subchlor.	..	..	..	grs. x.
		Theriac. . .	..	..	..	q.s.

Ft. electuar. Sig.: Administer on the tongue with a spoon.

- (2) R Sulphur. Sublim. 3iii. to 3vi.
 P. Mag. Sulph. 3viii. to 3x.
 Ft. pulv. i. Sig.: Give in the food or in the form of
 electuary.

Dogs.

CATHARTIC PILL.

- R Hydrarg. c̄ Cret. grs. ii.
 Pil. Colocynth. et Hyoscy. grs. iii.
 M. Ft. pil. i.

LAXATIVE PILLS.

- (1) R Ext. Casc. Sagr. Sicc. grs. ii.
 Ext. Nuc. Vom. Sicc. gr. $\frac{1}{10}$.
 Ext. Gentian. q.s.
 M. Ft. pil. i. Mitte xii. Sig.: Give from one to two
 pills as required.
- (2) R Ext. Casc. Sagr. Sicc. grs. ii.
 Ext. Nuc. Vom. Sicc. gr. $\frac{1}{10}$.
 Ext. Bellad. Sicc. gr. $\frac{1}{16}$.
 Ext. Gentian. q.s.
 M. Ft. pil. i. Mitte xii. Sig.: Give from one to two
 pills as required.

TONIC LAXATIVE PILLS.

- R Ferr. Carb. Sacch. grs v. to grs. x.
 Aloin. gr. $\frac{1}{10}$.
 Ext. Gentian. q.s.
 M. Ft. pil. i. Mitte xii. Sig.: Give from one to two
 pills twice daily.

APERIENT PILLS FOR PUPPIES.

- R Hydrarg. c̄ Cret. gr. ss.
 Sod. Bicarb. grs. iii.
 Excip. q.s.
 Ft. Pil. i. Sig.: Give one or more according to the age and
 size of the animal.

LAXATIVE MIXTURE ('MISTURA ALBA').

- R Mag. Sulph. 3vi.
 Mag. Carb. Lev. 3i.
 Aq. Menth. Pip. Dest. ad 3vi.
 Ft. M. Sig.: Give from two teaspoonfuls to two table-
 spoonfuls as required.

MIXTURE FOR HABITUAL CONSTIPATION.

- R Ext. Casc. Sagr. Liq. 3ii.
 Paraff. Liq. ad 3vi.
 Ft. M. Sig.: Give from a teaspoonful to a table-spoonful
 as required.

ASTRINGENTS.

Horses and Cattle.

ASTRINGENT DRAUGHT.

- R Tinct. Opii ʒi.
 Aquam ad O.ss.
 Ft. haust. Sig.: Give at once.

ASTRINGENT MIXTURE.

- R Cret. ʒiv.
 Tinct. Opii ʒv.
 Tinct. Catechu ʒv.
 Spt. Chlorof. ʒv.
 Aquam ad O.i.
 Ft. M. Sig.: Give two wineglassfuls three times a day
 in a pint of flour gruel.

POWDERS IN PERSISTENT DIARRHŒA.

- R Pulv. Opii ʒvi.
 Pulv. Catech. ʒi.ss.
 Cret. ʒiii.
 Pulv. Zingib. ʒvi.
 M. Div. in pulv. iii. Sig.: Give one every twelve hours
 in a pint of flour gruel until the diarrhœa ceases.

MIXTURE IN CHRONIC DIARRHŒA.

- R Ferr. Sulph. ʒx.
 Acid. Sulph. Dil. ʒx.
 Tinct. Zingib. Fort. ʒi.
 Aquam ad O.i.
 Ft. M. Sig.: Give two wineglassfuls once daily in a
 pint of flour gruel.

MIXTURE IN DYSENTERY.

- R Ol. Terebinth. ʒii.ss.
 Phenol. Liq. ʒv.
 Ext. Bellad. Liq. ʒii.ss.
 Aquam ad O.i.
 Ft. M. Sig.: Give two wineglassfuls twice daily in a
 pint of flour gruel.

FOR DIARRHŒA IN FOALS.

Commence treatment with a laxative as follows:

- R Ol. Ricin. ʒii.
 Ol. Menth. Pip. ℥v.
 Liq. Calc. Sacch. ʒii.

M. Ft. haust. Sig.: Give at once.

For foals over a week old the above doses may be doubled. If a stimulant be indicated, add 1 ounce of brandy to the draught.

If the above fails to check the diarrhoea, and if this be severe, the following mixture may be given:

R Tinct. Chloroform. et Morph. Co. .. \bar{z} iii.
 Cret. \bar{z} i.ss.
 Aq. Menth. Pip. Dest. ad \bar{z} vi.
 Ft. M. Sig.: Give two tablespoonfuls every three or
 four hours in starch gruel.

Or:

R Pulv. Catech. \bar{z} i.
 Cret. \bar{z} iii
 Tinct. Opii \bar{z} i.
 Aq. Menth. Pip. Dest. ad \bar{z} xii.
 Ft. M. Sig.: Give from $\frac{1}{2}$ to 1 wineglassful, repeated as
 required, in a little of the mare's milk.

MIXTURES IN DIARRHOEA IN CALVES.

(1) R Bismuth. Carb \bar{z} i.
 Tinct. Chloroform. et Morph. Co. .. \bar{z} i.
 Liq. Calc. Sacch. \bar{z} ii.
 Aq. Menth. Pip. Dest. ad \bar{z} iv.

M. Ft. haust. Sig.: Give as a draught mixed with a small
 teacupful of boiled milk; repeat twice daily as required.

(2) R Cret. \bar{z} ii.
 Tinct. Opii Camph. \bar{z} ii.ss.
 Tinct. Zingib. Mit. \bar{z} x.
 Aquam ad O.i.

Ft. M. Sig.: Give a wineglassful three times a day in
 $\frac{1}{2}$ pint of starch gruel.

If diarrhoea be severe, the following is useful:

R Pulv. Catech. \bar{z} i.
 Pulv. Cret. \bar{z} ii.
 Pulv. Opii \bar{z} iv.
 Pulv. Zingib. \bar{z} i.

Ft. pulv. Div. in pulv. xviii. Sig.: One powder in $\frac{1}{2}$ pint
 of boiled milk morning and evening.

Dogs.

ASTRINGENT DRAUGHT.

R Tr. Chloroform. et Morph. Co. .. \mathbb{M} x. to \mathbb{M} xv.
 Aquæ \bar{z} i. to \bar{z} ii.
 M. Ft. haust. Sig.: Give at once.

ASTRINGENT MIXTURES.

(1) R Cret. \bar{z} ss.
 Tinct. Opii Camph. \bar{z} vi.
 Aq. Menth. Pip. Dest. ad \bar{z} vi.
 Ft. M. Sig.: Give from two teaspoonful to a table-
 spoonful every three or four hours.

- (2) R Bismuthi Carb. ʒi.ss.
 Sod. Bicarb. grs. xl.
 Tinct. Chloroform. et Morph. Co. ℥xl.
 Aq. Menth. Pip. Dest. ad ʒvi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful every three hours as required.

MIXTURE FOR DIARRHŒA IN PUPPIES.

- R P. Cret. grs. xl.
 Tinct. Opii Camph. ʒi.
 Aq. Chloroform. ad ʒii.

Ft. M. Sig.: Give from half to one teaspoonful every three hours until the diarrhœa is checked.

ASTRINGENT POWDERS.

- R P. Kaolin. grs. x to grs. xx.
 Pulv. Ipecac. et Opii grs. v. to grs. x

M. Ft. pulv. i. Mitte vi. Sig.: Give one every three hours as required.

HÆMATINICS.

Horses.

TONIC MIXTURES.

- (1) R Ferr. et Ammon. Cit. ʒx.
 Tinct. Nuc. Vom. ʒx.
 Tinct. Calumb. ʒv.
 Glycer. ʒiii.
 Aquam ad O.i.

Ft. M. Sig.: Give two wineglassfuls three times a day in a pint of ale.

- (2) R Quinin. Sulph. ʒii.ss.
 Acid. Sulph. Dil. ʒiii.
 Tinct. Calumb. ʒv.
 Glycerin. ʒiii.
 Aquam ad O.i.

Ft. M. Sig.: Two wineglassfuls three times a day in a pint of ale.

TONIC BOLUS.

- R Ferr. Sulph. Exsic. ʒi.
 Ext. Nuc. Vom. Sicc. gr. x.
 Pulv. Gentian. ʒii.
 Theriac. q.s.

Ft. bol. i. Mitte xii. Sig.: Give one twice a day.

TONIC POWDERS.

- R P. Ferr. Sulph. Exsic. ʒvi.
 P. Gentian. ʒi.ss.
 P. Anis. ʒiii.

M. Div. in pulv. vi. Sig.: Give one twice a day in the food.

Cattle.

TONIC MIXTURE.

R	Ext. Nuc. Vom. Liq.	..	..	..	3v.
	Tinct. Calumb.	..	..	..	3v.
	Tinct. Zingib. Mit.	..	..	..	3ii.ss.
	Aquam	..	..	..	ad O.i.

Ft. M Sig.: Give two wineglassfuls three times a day in 2 pints of ale and $\frac{1}{2}$ pound of treacle.

TONIC POWDERS.

R	Ferr. Sulph. Exsic.	..	..	..	3i.
	Mag. Sulph.	..	..	..	3xii.
	Pulv. Nuc. Vom.	..	..	..	3i.
	Pulv. Gentian.	..	..	..	3vi.

M. Div. in pulv. vi. Sig.: Give one twice a day dissolved in 2 pints of ale and $\frac{1}{2}$ pound of treacle, or give in the form of electuary.

Dogs.

TONIC MIXTURES.

(1)	R	Ferr. et Ammon. Cit.	..	..	..	3ii.
		Liq. Arsen. et Hydrarg. Iod.	..	..	..	3i.
		Aquam	..	..	..	ad 3iv.

Ft. M. Sig.: One to two teaspoonfuls to be given twice daily after food.

(2)	R	Ferr. et Quinin. Cit.	..	..	..	3ii.
		Syr.	..	..	..	3ii.
		Aquam	..	..	..	ad 3vi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful three times a day.

TONIC ALKALINE MIXTURE DURING CONVALESCENCE FROM GASTRITIS.

R	Liq. Bism. et Ammon. Cit.	..	..	..	3i.ss.
	Sod. Bicarb.	..	..	..	3i.
	Tinct. Nuc. Vom.	..	..	..	3ss.
	Syr.	..	..	..	3i.
	Aquam	..	..	..	ad 3vi.

Ft. M. Sig.: Give from two teaspoonfuls to a table-spoonful three times daily.

TONIC PILLS.

(1)	R	Ferr. Carb. Sacc.	..	..	..	gr. ii.
		Quinin. Sulph.	..	..	..	gr. ss.
		Strych. Hydrochlor.	..	..	..	gr. $1\frac{1}{2}$ o.
		Ext. Gentian.	..	..	..	q.s.

Ft. pil. i. Mitte xii. Sig.: Give from one to two pills twice a day.

- (2) R Pil. Ferr. Carb. grs. v.
 Arsen. Trioxid. gr. $\frac{1}{100}$.
 Excipient. q.s.

Ft. pil. i. Mitte xii. Sig.: Give from one to two pills
 twice a day.

'CLEANSING' DRAUGHT FOR COWS.

- R Ergot. Præp. $\bar{3}$ i.
 Mag. Sulph. $\bar{3}$ xii.
 Pulv. Zingib $\bar{3}$ i.
 Pulv. Anis. $\bar{3}$ ii.

M. Sig.: To be given in 2 pints of warm ale, with
 1 pound of treacle.

COUNTER-IRRITANTS.

FOR ACTIVE COUNTER-IRRITATION

- (1) R Pulv. Cantharidis $\bar{3}$ vii.
 Ol. Terebinth $\bar{3}$ vi.
 Acid. Acet. $\bar{3}$ iv.ss.
 Adeps lb. ii.ss.

Mix the cantharides, turpentine and acetic acid; then melt
 the lard and incorporate the mixture in it.

RED IODIDE BLISTER.

- (2) R Hydrarg. Iod. Rubr. $\bar{3}$ ii.
 Paraff. Liq. $\bar{3}$ iv.
 Adipis Lan. Hydros. } āā lb. ss.
 Paraff. Moll. Flav. }

Thoroughly mix the iodide of mercury and liquid paraffin
 in a mortar, then melt the lard and vaseline and
 thoroughly incorporate.

LINIMENTS.

ABSORBENT LINIMENTS.

- (1) R Iod. $\bar{3}$ i.
 Pot. Iod. $\bar{3}$ ii.
 Glycer. $\bar{3}$ xvi.

M. Ft. lin.

- (2) R Sap. Animal. $\bar{3}$ ii.
 Pot. Iod. $\bar{3}$ i.ss.
 Glycer. $\bar{3}$ i.
 Ol. Origan. $\bar{3}$ i.
 Aquæ $\bar{3}$ x.

Reduce the curd soap to fine shreds; mix it with the
 water and glycerin in a porcelain dish on a water-
 bath. When the soap is dissolved, pour the liquid
 into a mortar in which the potassium iodide has pre-
 viously been powdered, mix by trituration, and
 continue stirring until the mixture is cold; set aside
 for an hour, then rub the oil of origanum into the
 cream-like product.

STIMULATING LINIMENTS.

- (1) R Sap. Mol. ℥iv.
 Ammon. Chlorid. ℥i.ss.
 Aq. Ferv. O.iii.
 Ol. Terebinth. ℥v.
 Liq. Ammon. Fort. ℥ii.

Ft. lin.

Triturate the chloride of ammonia with the soap. Add the hot water in small quantities, continually stirring. Pour into a Winchester quart bottle and add the turpentine in small quantities, shaking thoroughly after each addition. Finally, when the mixture is cold, add the ammonia and shake vigorously.

If a stronger liniment be required, the quantities of turpentine and liquor ammonia may be increased.

- (2) R Sap. Mol. ℥ii.
 Pulv. Camph. ℥iv.
 Ol. Terebinth. ℥xvi.

Digest in a large wide-mouthed bottle for a week, and shake frequently. Then add very gradually (2 ounces at a time) 24 ounces of water, and shake the bottle vigorously during the process. Add 6 ounces of ammonium chloride dissolved in a pint of warm water, and shake well together. Then add gradually 3 pints of water and shake, and add 6 ounces of strong solution of ammonia. After again shaking well together, add 2 pints of water. The above makes 1 gallon of liniment, the constituents of which do not separate. If a stronger liniment be required, the quantities of turpentine and ammonia may be increased.

STRONG STIMULATING LINIMENT SUITABLE FOR CATTLE.

- R Liq. Ammon. Fort. ℥ii.
 Ol. Terebinth. ℥ii.
 Ol. Lini ℥viii.

M. Ft. lin.

Dogs.

ASTRINGENT AND SEDATIVE LINIMENTS.

- (1) R Zinc. Oxid. ℥iii.ss.
 Adipis Lan. Hydros. ℥ss.
 Liq. Calc. Sacc. ℥iv.
 Ol. Oliv. ℥iv.

M. Ft. lin. Sig.: Apply twice daily.

- (2) R Zinc. Carb. Præp. ℥iii.
 Zinc. Oxid. ℥ii.
 Liq. Calc. Sacc. ℥iv.
 Ol. Oliv. ℥iv.

M. Ft. lin. Sig.: Apply twice daily.

ASTRINGENT AND PARASITICIDE LINIMENT FOR CATS.

R	Sulphur. Præcip.	..	..	..	℥i.
	Zinc. Carb. Præp.	..	..	..	℥i.
	Glycer.	..	..	..	℥ii.
	Liq. Calc. Sacc.	..	..	..	℥iv.
	Aq. Rosæ.	..	..	..	℥iv.

M. Ft. lin. Sig.: Apply twice daily.

PARASITICIDE LINIMENTS.

For Parasitic Mange in the Horse.

R	Sulphur. Sublim.	..	..	..	℥viii.
	Pot. Carb.	..	..	..	℥ii.
	Ol. Pic. Liq.	..	..	..	℥iv.
	Ol. Cetac.	..	..	..	ad O.ii.

M. Ft. lin. Sig.: Apply over affected parts. Wash off on the third day and reapply.

For Sarcoptic Mange in the Horse.

R	Sulphur. Sublim.	..	..	..	℥x.
	Ol. Cetac.	..	..	..	O.ii.

M. Ft. lin.

Directions.

1st day: (a) Clip, singe, and wash with hard soap and warm water.

(b) Dress. Rub in dressing thoroughly with an old body-brush. A body-brush cut in half makes two convenient appliances.

2nd day: Reapply dressing to spots that appear to be irritable, or from which the dressing has been removed by contact.

3rd day: Reapply dressing as directed for second day.

10th day: Cleanse thoroughly with hard soap and warm water.

11th day: Dress as on first day.

12th day: Reapply dressing as directed for second day.

13th day: Reapply dressing as directed for second day.

21st day: Cleanse thoroughly with hard soap and warm water.

22nd day: Dress as on first day.

23rd day: Reapply dressing as directed for second day.

24th day: Reapply dressing as directed for second day.

30th day: Wash off finally, sweat, and groom daily for a week.

If still irritable after a week, proceed again with treatment for a second month.

Dressing for Psoroptic Mange; also useful for dressing 'In-Contacts' and for Disinfection of Fomites, etc.

Paraffin Oil	..	..	..	1 pint.
Solution of Hard Soap	..	..	..	1 gallon.

Prepare the soap solution by cutting in small pieces 1 pound of hard soap; add this to 1 gallon of warm water in a pot. Simmer it over a slow fire until the soap is dissolved.

Remove from the fire and (while hot) add the paraffin oil, and stir thoroughly until the mixture becomes of a creamy consistence.

Apply the dressing with a brush, and wash it off on the fourth day, and if necessary reapply. As the oil tends to float to the surface of the dressing, it is necessary to stir it frequently, while carrying out the application; otherwise the oil will be taken up by the brush, and may cause serious irritation of the skin.

Liniments for Otodectic Mange in the Dog.

- (1) R Bals. Peruv. } āā ʒi.
Glycer. }
M. Ft. lin.
- (2) R Ol. Anis. ʒii.
Ol. Oliv. ad ʒii.
M. Ft. lin.

Sig.: After cleansing the ears with a pledget of cotton-wool soaked in alcohol (70 per cent.), pour in a little of one of these liniments.

PROTECTIVE AND FLY REPELLENT WOUND DRESSING.

- R Creosot. ʒii.
Tereben. ʒvi.
Ol. Oliv. ad O.i.
Ft. lin.

LINIMENT FOR TRAUMATIC ARTHRITIS.

- R Hydrarg. Perchlor. ʒii.
Glycer. ʒii.
M. Ft. lin. Sig.: Apply with a camel-hair brush once a day.

LIQUID SOAP.

For Washing Dogs, etc.

- R Sap. Moll. lb. i.
Sp. Meth. Indust. ʒxvi.
Ol. Eucalyp. ʒi.
M.

This also forms a useful basis for skin liniments; agents such as sulphur, cyllin, etc., may with advantage be added.

ETHER SOAP (*Martindale*).

As Detergent for the Hands.

- R Sap. Moll. ʒiv.
Alcohol (90 per cent.) ʒii.ss.
Mix, and after 24 hours carefully decant from the sediment,
then add:
Æther. ʒvi.ss.

LOTIONS.

ABSORBENT LOTION FOR BURSAL ENLARGEMENTS.

- R Hydrarg. Iod. Rubr. ʒi.
 Pot. Iod. ʒss.
 Aquæ ʒxii.
- M. Ft. lotio. Sig.: Apply once or twice daily until the part becomes scaly and tender, then discontinue and reapply after an interval of one week.

LOTION FOR FÆTID SEBORRHEA AND CHRONIC FISSURED HEELS.

- R Plumb. Acet. ʒi.
 Zinc. Sulph. ʒi.
 Cupr. Sulph. ʒi.
 Aquæ O.i.
- M. Ft. lotio. Sig.: Thoroughly cleanse the affected part twice daily by means of pledgets of cotton soaked in the lotion.

'WHITE LOTION' (*Dick*).

- R Plumb. Acet. ʒi.
 Zinc. Sulph. ʒvi.
 Aquæ O.i.
- M. Ft. lotio.

SEDATIVE LOTION FOR STRAINED TENDONS, ETC.

- (1) R Liq. Plumb. Subacet. Fort. ʒiv.
 Sp. Meth. Indust. ʒi.
 Aquam ad O.i.
- M. Ft. lotio. Sig.: Soak bandages in the lotion, and apply to the affected limbs.
- (2) R Liq. Plumb. Subacet. Fort. ʒii.
 Ol. Olivæ ʒviii.
- M. Ft. lin.

LINIMENT FOR APPLICATION AFTER COUNTER-IRRITATION.

- R Pot. Carb. ʒss.
 Ol. Oliv. ʒx.
 Ol. Eucalypt. ʒi.
 Aquæ ʒx
- M. Ft. lin.

REFRIGERANT LOTION.

- R Ammon. Chlorid. ʒi.
 Plumb. Acet. ʒi.
 Alum. ʒi.
 Acet. (Vinegar) O.ii.
 Aquæ O.i.
- M. Ft. lotio. Sig.: Soak bandages in the lotion, and apply to the affected limbs.

COLLYRIA.

- (1) R Acid. Boric. grs. viii.
 Aq. Ros. ℥iii.
 M Ft. collyr. Sig.: Instil a few drops by means of an
 eye-dropper three times daily.

- (2) R Argent. Nit. grs. ii.
 Aq. Dest. ℥i.
 M. Ft. collyr.

- (3) R Zinc. Sulph. grs. viii.
 Aq. Dest. ℥iv.
 M. Ft. collyr.

If Pain be Pronounced.

- (4) R Procain. Hydrochlor. grs. ii.
 Acid. Boric. grs. iv.
 Aquæ ℥i.
 M. Ft. collyr.

COLLUTORIA.

Horses.

- R Pot. Chlorat. ℥ii.
 Borac. ℥iii.
 Glycer. ℥ii.
 Aquam ad O.i.

- M. Ft. collut. Sig.: Rinse the mouth with two wine-
 glassfuls of the lotion three times daily.

Dogs.

- R Borac. ℥ii.
 Sod. Bicarb. grs. xl.
 Glycer. ℥ss.
 Aquam ad ℥viii.

- M. Ft. collut. Sig.: Rinse the mouth with a little of the
 lotion three times daily.

MOUTH-WASHES FOR ULCERATIVE STOMATITIS IN THE DOG.

- (1) R Pot. Chlorat. grs. xxx.
 Ac. Hydrochlor. Dil. ℥xv.
 Aquam ad ℥x.

- M. Ft. collut. Sig.: Mix a little of the lotion with an equal
 quantity of tepid water and apply to the gums, cheeks,
 etc., with a pledget of cotton-wool.

[Put the powdered potassium chlorate in the bottle, add
 the hydrochloric acid, and let the generated gas replace
 the air; then cork and let it stand for two minutes; finally
 add the water in small quantities, shaking after each
 addition.]

- (2) R Liq. Formaldehyd. ℥xx.
 Aquam ad ℥x.
 M. Ft. collut. Sig.: Apply as directed for (1).

INTRATRACHEAL INJECTION FOR PARASITIC
BRONCHITIS IN CALVES.

- R Phenol. Liq. ʒiv.
 Ol. Terebinth. ʒx.
 Pot. Carb. ʒi.ss.
 Ol. Oliv. ʒv.
 Aquam ad ʒxx.
- M. Ft. emuls. Sig.: Administer $\frac{1}{2}$ ounce by intratracheal injection once daily for three consecutive days.

LOCAL ANÆSTHETICS.

- (1) R Procain. Hydrochlor. grs. ix.
 Liq. Adrenal. Hydrochlor. ℥xvi.
 Aq. Dest. ʒi.
- M. Sig.: Inject hypodermically from 10 to 20 minims at different points in the region to be rendered anæsthetic.
- (2) R Procain. Hydrochlor. grs. viii.
 Cocain. Hydrochlor. gr. i.
 Sod. Chlor. grs. ii.
 Pot. Sulph. gr. i.
 Aq. Dest. ʒi.

M.

Experience has shown that this solution is equivalent in its anæsthetic action to a 5 per cent. solution of cocaine, but is practically non-toxic.

The amount injected depends upon the nature of the operation, but usually does not exceed 20 c.c. for the horse and 5 c.c. for the dog [*R.(D.)V.C.*].

COCAINE INJECTION FOR THE DIAGNOSIS OF LAMENESS IN THE HORSE.

- R Cocain. Hydrochlor. grs. ii.
 Aq. Dest. ʒi.
- Ft. injectio. Sig.: Inject half into the region of the plantar nerves at each side of the limb, just above the fetlock.

HYPERTONIC SALINE SOLUTION FOR WOUND
IRRIGATION.

- R Sod. Chlorid. ʒvii.
 Sod. Cit. grs. xlv.
 Aquæ O.i.

Ft. lotio.

OINTMENTS.

ANTISEPTIC.

- R P. Iodof. ʒii.
 P. Acid. Boric. ʒii.
 Ol. Eucalyp. ʒi.
 Adipis Lan. Hydros. lb. ss.
 Paraff. Moll. Flav. lb. ss.

M. Ft. ung.

ASTRINGENT AND ANTISEPTIC.

- (1) R Pulv. Plumb. Acet. ℥iv.
 Pulv. Plumb. Carb. ℥iv.
 Pulv. Camph. ℥ii.
 Ol. Eucalyp. ℥ii.
 Adipis Lan. Hydros. lb. i.
 Paraff. Moll. Flav. lb. i.
- M. Ft. ung. Melt the lanolin and soft paraffin, then add the two salts of lead, mix thoroughly, add the camphor and the oil of eucalyptus, and incorporate the whole in a mortar.
- (2) R Pulv. Zinc. Oxid. ℥iv.
 Pulv. Zinc. Carb. Præp. ℥ii.
 Pulv. Sulphur. Sublim. ℥ii.
 Pulv. Acid. Boric. ℥ii.
 Ol. Eucalyp. ℥i.
 Adipis Lan. Hydros. lb. ss.
 Paraff. Moll. Flav. lb. ss.
- M. Ft. ung. Melt the lanolin and soft paraffin, add the eucalyptus-oil, mix the zinc salts, sulphur, and boric acid together, and incorporate thoroughly in a mortar.

ABSORBENT OINTMENTS.

- (1) R Pot. Iod. ℥ii.
 Adipis Lan. Hydros. lb. ss.
 Paraff. Moll. Flav. lb. ss.
- M. Ft. ung. Powder the potassium iodide finely; melt the bases, and thoroughly incorporate in a mortar.
- (2) R Iod. ℥ii.
 Pot. Iod. ℥ii.
 Adipis Lan. Hydros. lb. ss.
 Paraff. Moll. Flav. lb. ss.
 Aquæ ℥ii. ss.
- M. Ft. ung. Dissolve the potassium iodide in the water; add the iodine, and when dissolved mix with the bases.

For the Reduction of Bursal Enlargements, etc.

- (3) R Iod. ℥ii.
 Pot. Iod. ℥i.
 Pic. Liq. } āā lb. ss.
 Sap. Moll. }
 Aquæ ℥i. ss.

Mix together. Sig.: Apply once daily until the part becomes tender and scaly.

FOR THE TREATMENT OF MALLENDERS AND SALLENDERS.

- R Cresol. ℥ii.
 Ung. Hydrarg. Ammon. ℥iv.
- M. Ft. ung. Sig.: Apply twice a day.

HOOF OINTMENT.

- R Pic. Liq. lb. i.
 Ceræ Flav. lb. i.
 Glycer. ℥xii.
 Adipis Lan. Hydros. lb. iii.
 Paraff. Moll. Flav. lb. iii.
- M. Ft. ung. Melt the lanolin, soft paraffin, and beeswax together, then stir in the other ingredients, and incorporate thoroughly.

Dogs.

ASTRINGENT OINTMENT.

- R Zinc. Oxid. ℥i.
 Zinc. Carb. Præp. ℥i.
 Adipis Lan. Hydros. ℥viii.
 Paraff. Moll. Flav. ℥viii.
- M. Ft. ung. Sift the zinc salts thoroughly; melt the bases, and incorporate in a mortar. Sig.: Apply twice daily.

OINTMENT FOR CHRONIC ECZEMA.

- R Ol. Cadin. ℥i.
 Zinc. Oxid. ℥i.
 Adipis Lan. Hydros. ℥iv.
 Paraff. Moll. Flav. ℥iv.
- M. Ft. ung. Sig.: Apply once a day.

PARASITICIDE OINTMENT FOR SMALL DOGS.

- R Zinc. Oxid. ℥i.
 Sulphur. Præcip. ℥i.
 Bals. Peruv. ℥ss.
 Adipis Lan. Hydros. ℥iv.
 Paraff. Moll. Flav. ℥iv.
- M. Ft. ung. Melt the basis with the balsam of Peru, and stir in the other constituents. Sig.: Apply once daily.

STAINLESS IODINE OINTMENT.

- R Iod. ℥iv.
 Acid. Oleic. lb. i.

Melt in a water-bath and add:

- Adipis Lan. Hydros. lb. ss.
 Paraff. Moll. Alb. lb. ss.

and mix well together. This ointment can be made stronger by reducing the amount of lanolin and soft paraffin.

APPENDIX II

THERMOMETRIC EQUIVALENTS.

° C.	° F.	° C.	° F.	° C.	° F.	° C.	° F.
0	32·0	27	80·6	49	120·2	75	167·0
1	33·8	28	82·4	50	122·0	76	168·8
2	35·6	29	84·2	51	123·8	77	170·6
3	37·4	30	86·0	52	125·6	78	172·4
4	39·2	31	87·8	53	127·4	79	174·2
5	41·0	32	89·6	54	129·2	80	176·0
6	42·8	33	91·4	55	131·0	81	177·8
7	44·6	34	93·2	56	132·8	82	179·6
8	46·4	35	95·0	57	134·6	83	181·4
9	48·2	36	96·8	58	136·4	84	183·2
10	50·0	37	98·6	59	138·2	85	185·0
11	51·8	37·5	99·5	60	140·0	86	186·8
12	53·6	38	100·4	61	141·8	87	188·6
13	55·4	38·5	101·3	62	143·6	88	190·4
14	57·2	39	102·2	63	145·4	89	192·2
15	59·0	39·5	103·1	64	147·2	90	194·0
16	60·8	40	104·0	65	149·0	91	195·8
17	62·6	40·5	104·9	66	150·8	92	197·6
18	64·4	41	105·8	67	152·6	93	199·4
19	66·2	42	107·6	68	154·4	94	201·2
20	68·0	43	109·4	69	156·2	95	203·0
21	69·8	44	111·2	70	158·0	96	204·8
22	71·6	45	113·0	71	159·8	97	206·6
23	73·4	46	114·8	72	161·6	98	208·4
24	75·2	47	116·6	73	163·4	99	210·2
25	77·0	48	118·4	74	165·2	100	212·0
26	78·8						

COMPARISON BETWEEN STANDARD WIRE GAUGE, INCHES, AND MILLIMETRES.

This table is convenient for the purpose of describing the sizes of cannulæ and hypodermic needles.

S.W.G.	Inches.	Milli- metres.	S.W.G.	Inches.	Milli- metres.
1	0·300	7·62	15	0·072	1·83
2	0·276	7·01	16	0·064	1·63
3	0·252	6·41	17	0·056	1·42
4	0·232	5·89	18	0·048	1·22
5	0·212	5·38	19	0·040	1·01
6	0·192	4·87	20	0·036	0·914
7	0·176	4·47	21	0·032	0·813
8	0·160	4·06	22	0·028	0·711
9	0·144	3·66	23	0·024	0·610
10	0·128	3·25	24	0·022	0·560
11	0·116	2·95	25	0·020	0·508
12	0·104	2·65	26	0·018	0·457
13	0·092	2·33	27	0·016	0·406
14	0·080	2·03	28	0·014	0·356

APPENDIX III

I. THE LAW RELATING TO DANGEROUS DRUGS.

THE principal Act regulating the supply and possession of dangerous drugs is the Dangerous Drugs Act, 1920. It has been amended by the Dangerous Drugs and Poisons (Amendment) Act, 1923, and the Dangerous Drugs Acts, 1925 and 1932.* The principal Act is in four parts. Part I., as amended by the 1925 Act (Sec. 1), deals with raw opium and certain other substances. Part II. absolutely prohibits any dealing in opium prepared for smoking. Part III., as amended by the 1925 and 1932 Acts, deals with medicinal opium, morphine, cocaine, and other substances. Part IV. is administrative, and deals with penalties, etc.

Part I. Drugs.

The drugs to which Part I. applies are raw opium, including powdered or granulated opium, but not medicinal opium, coca leaves (*i.e.*, the leaves of any plant of the genus of the *Erythroxylaceæ* from which cocaine can be extracted either directly or by chemical transformation), Indian hemp (*i.e.*, the dried flowering or fruiting tops of the pistillate plant known as *Cannabis sativa*, from which the resin has not been extracted, by whatever name such tops are called), and resins obtained from Indian hemp, and all preparations of which such resins form the base. The only provisions in the Act relating to these drugs are prohibitions of import and export except under licence and into and from approved ports, and for the making of Regulations regarding their production, possession, sale, and distribution.

The following is the substance of the Regulations:† No one may supply or procure, or offer to supply or procure, the drugs to or for any person, whether in the United Kingdom or elsewhere, or be in possession, or attempt to obtain possession of them, unless he is licensed by a Secretary of State or authorized by the Regulations or by a Secretary of State. A general authorization to be in possession of and supply the drugs, so far as is necessary

* The 1932 Act was brought into force on July 9, 1933, by Order in Council, S. R. and O., 1933, No. 487.

† Statutory Rules and Orders, 1937, No. 559.

for the practice of their profession or employment, is conferred by the Regulations on registered medical practitioners, pharmaceutical chemists, chemists and druggists, dispensers in public hospitals, registered veterinary surgeons, persons in charge of research or instructional laboratories, public analysts and sampling officers under the Food and Drugs (Adulteration) Act, 1928. The drugs may be supplied to persons not authorized to be in possession only in accordance with this authority, and accordingly they may be supplied by a medical or veterinary practitioner only so far as is necessary for the practice of his profession. Further, they may not be supplied to a messenger purporting to act for a person authorized to be in possession unless the messenger produces an authority in writing and the supplier is satisfied as to the genuineness of the signature. Every person supplying the drugs must enter in a register all supplies obtained by him and dealings effected by him in the following form:

PART I.

Entries to be made in case of drugs obtained.

The kind of drug to which the entries relate to be specified at the head of each page in the Register.

<i>Date on which Supply Received.</i>	<i>Name</i>	<i>Address</i>	<i>Amount Obtained.</i>
	<i>of Person or Firm from whom Obtained.</i>		

PART II.

Entries to be made in case of drugs supplied.

The kind of drug to which the entries relate to be specified at the head of each page in the Register.

<i>Date on which the Transaction was Effected.</i>	<i>Name</i>	<i>Address</i>	<i>Authority of Person or Firm Sup- plied to be in Possession.</i>	<i>Amount Supplied.</i>
	<i>of Person or Firm to whom Supplied.</i>			

The 'Register' must be a bound book.

Separate registers or separate parts of the register must be kept for (i) raw opium, (ii) coca leaves, (iii) Indian hemp and resins obtained from Indian hemp and all preparations (other than extract and tincture of Indian hemp) of which such resins form the base. The entry must be made on the day of the transaction, or, if that is not reasonably convenient, on the day following. No entry may be cancelled or altered, but a mistake must be corrected by a dated marginal or foot note. The register or registers must be available for inspection at all reasonable times and must be preserved for a period of two years from the date of the last entry made therein.

Part III. Drugs.

The drugs to which Part III. applies are (a) medicinal opium; (b) any extract or tincture of Indian hemp; (c) morphine and its salts, and diacetyl-morphine (commonly known as diamorphine or heroin) and the other esters of morphine and their respective salts; (d) cocaine (including synthetic cocaine) and ecgonine and their respective salts, and the esters of ecgonine and their respective salts; (e) any solution or dilution of morphine or cocaine or their salts in an inert substance, whether liquid or solid, containing any proportion of morphine or cocaine, and any preparation, admixture, extract, or other substance (not being such a solution or dilution as aforesaid) containing not less than $\frac{1}{2}$ per cent. of morphine or $\frac{1}{10}$ per cent. of cocaine or of ecgonine; (f) any preparation, admixture, extract, or other substance containing any proportion of diacetyl-morphine; (g) dihydro-hydroxy-codeinone, dihydro-codeinone, dihydro-morphinone, acetyl-dihydro-codeinone, dihydro-morphine, their esters and the salts of any of these substances and of their esters, morphine-N-oxide (commonly known as genomorphine), the morphine-N-oxide derivatives, and any other pentavalent nitrogen morphine derivatives; (h) thebaine and its salts, and (with the exception of methyl-morphine, commonly known as codeine, and ethyl-morphine, commonly known as dionin, and their respective salts) benzoyl-morphine and the other ethers of morphine and their respective salts; (i) any preparation, admixture, extract, or other substance containing any proportion of any of the substances mentioned in paragraph (g) or in paragraph (h).

The Act merely regulates the import and export of these drugs, which are prohibited except under licence, and provides for the making of Regulations controlling their manufacture, sale, possession, and distribution.

The Regulations* apply not only to Part III. drugs (except benzoyl-morphine, with regard to which there are special Regulations,† under which no one may be in possession of or supply that drug unless he is specially licensed or authorized by a Secretary of State), but also to 'preparations,' except those scheduled, or drugs or preparations denatured as approved by the Secretary of State or falling within the provisions of S. R. and O., 1937, No. 327. A preparation is any preparation, admixture, extract, or other substance containing such a proportion of a Part III. drug (other than benzoyl-morphine) as is sufficient to make the preparation, admixture, extract, or substance a drug to which Part III. applies. The following are the scheduled drugs and preparations: (*i.e.* drugs and preparations exempted from these Regulations).

- Pasta Arsenicalis, B.P.C. 1934.
- Pil. Ipecac. c. Scilla, B.P.C. 1934.
- Pil. Digitalis et Opii Co., B.P.C. 1923.
- Pil. Hydrarg. c. Cret. et Opii, B.P.C. 1934.
- Pulv. Cretæ Aromat. c. Opio, B.P. 1932.
- Pulv. Ipecac. et Opii, B.P. 1932.
- Suppos. Plumbi c. Opio, B.P. 1932.
- Tabellæ Plumbi c. Opio, B.P.C. 1934.
- Elixir Diamorphinæ et Terpini c. Apomorphina, B.P.C. 1934.
- Linctus Diamorphinæ Camphoratus, B.P.C. 1923 and 1934.
- Linctus Diamorphinæ c. Ipecacuanha, B.P.C. 1934.
- Linctus Diamorphinæ et Scillæ, B.P.C. 1923 and 1934.
- Linctus Diamorphinæ et Thymi, B.P.C. 1923 and 1934.
- Mixtures of Pulv. Ipecac. et Opii, B.P. 1932 with any of the following:
 - Hydrarg. c. Cret., B.P. 1914 and 1932.
 - Acetylsalicylic Acid.
 - Phenacetin.
 - Quinine and its Salts.
 - Sodium Bicarbonate.

Cocaine Eyedrops—a preparation consisting of an admixture of cocaine in castor oil with mercuric chloride in a proportion of not more than one part in 200 of cocaine and not less than one part in 3,000 of mercuric chloride.

Methylmorphine and ethylmorphine and their respective salts and any preparation, admixture or other substance containing any proportion of methylmorphine or ethylmorphine associated with an inert substance, whether solid or liquid; and preparations and admixtures or other substances containing more than 2·5 per cent. of methylmorphine or ethylmorphine (calculated as pure drug) associated with other medicinal substances.

The Regulations prohibit the manufacture of a Part III. drug without authority. No one may supply or procure, or offer

* S. R. and O., 1937, No. 560.

† S. R. and O., 1928, No. 925.

to supply or procure, to or for any person, whether in Great Britain or elsewhere, or be in possession of these drugs or preparations, unless authorized, and then only in accordance with the conditions of his authority.

A general authorization to be in possession of and supply these drugs and preparations is given to the same persons who are authorized to be in possession and supply Part I. drugs, and also to registered dental surgeons, 'so far as may be necessary for the practice or exercise of their respective professions or employments.' A person is also authorized to be in possession if the drug or preparation is lawfully supplied to him, either on a prescription lawfully given by a registered medical practitioner, dentist, or veterinary surgeon, or by a registered medical practitioner or veterinary surgeon who dispenses his own medicines.

A prescription directing the supply of such drugs or preparations must comply with the following requirements: (a) It must be in writing, signed by the person giving it with his usual signature, and dated by him; (b) it must specify the address of the person giving it; (c) it must specify, if given by a veterinary surgeon, the name and address of the person to whom the article prescribed is to be delivered; (d) if given by a veterinary surgeon, it must bear the words 'For animal treatment only'; and (e) if it prescribes a preparation contained or compounded of preparations all of which are contained in the British Pharmacopœia, or the British Pharmaceutical Codex, or the Drug Tariff issued by the Minister of Health for the purposes of national health insurance. It must specify the total amount of the preparation or of each preparation, as the case may be, and in any other case the total amount of the drug to be supplied.

Such drug or preparation may not be dispensed unless the prescription complies with these requirements, and unless the person supplying is acquainted with the signature of the person by whom the prescription purports to have been given, and has no reason to suppose that it is not genuine, or has taken reasonably sufficient steps to satisfy himself that it is genuine. The drug or preparation may be dispensed on a prescription once only, unless the prescription expressly states that it may, subject to the lapse of a specified interval or intervals, be dispensed two or three times. Three times is the maximum. The person dispensing must retain the prescription, and mark on it the date or dates on which the drug was supplied.

Where a drug is supplied, whether direct by a veterinary surgeon or on a prescription, the package or bottle must be plainly marked with the amount of the drug it contains; where a preparation is supplied, the package or bottle must be marked,

in the case of a powder, solution, or ointment, with the total amount thereof and the percentage of the drug, and, in the case of tablets or other similar articles, with the amount of the drug in each article and the number of articles in the package or bottle. The supplier may not deliver to a messenger purporting to act for the recipient unless the messenger himself is authorized to be in possession or produces written authority from the recipient and the supplier is satisfied that the document is genuine.

Every person authorized to supply such drugs or preparations must keep a register and enter particulars of quantities obtained and supplied by him in this form:

DRUGS OR PREPARATIONS OBTAINED.

<i>Date on which Received.</i>	<i>Name</i>	<i>Address</i>	<i>Amount Obtained.</i>	<i>Form in which Obtained.</i>
	<i>of Person or Firm from whom Obtained.</i>			

DRUGS OR PREPARATIONS SUPPLIED.

<i>Date of Trans- action.</i>	<i>Name</i>	<i>Address</i>	<i>Authority of Person or Firm Supplied to be in Possession.</i>	<i>Amount Supplied.</i>	<i>Form in which Supplied.</i>
	<i>of Person or Firm to whom Supplied.</i>				

A separate register or a separate part of the register must be used for each of the following classes of drugs and preparations: (i.) Cocaine and ecgonine, and preparations containing cocaine or ecgonine; (ii.) morphine, and preparations containing morphine; (iii.) diacetyl-morphine, and preparations containing diacetyl-morphine; (iv.) medicinal opium; (v.) extracts or tinctures of Indian hemp; (vi.) dihydro-hydroxycodine, and preparations containing it; (vii.) dihydro-codeine, and preparations containing it and (viii.) dihydro-morphine, and preparations containing it. The class of drug or preparation to which the entries

relate must be specified at the head of each page. The entry must be made on the day on which the drug or preparation was obtained or supplied, or, if that is not reasonably practicable, the day following. No alteration of an entry may be made. Any correction must be by a dated marginal or foot note. Entries and corrections must be in ink or otherwise indelible. The register must be available on the premises to which it relates for inspection at all reasonable times, and it must be preserved for two years from the date of the last entry.

II. THE LAW RELATING TO POISONS.

In the same way as it has been considered necessary to exercise control over the distribution of Dangerous Drugs because of the anti-social effects of their abuse, the distribution of poisons is controlled because of their obvious danger to the community. Poisons are subject to the provisions of the Pharmacy and Poisons Act, 1933, and the aftermentioned Statutory Orders made thereunder.

The Act established an Advisory Committee called the Poisons Board, to which it was remitted to prepare and submit to the Secretary of State a list of the substances to be treated as poisons under the Act divided into two parts: (1) Part I consisting of those poisons which were not to be sold except by 'an authorized seller of poisons,' and (2) Part II consisting of those poisons which were not to be sold except by an authorized seller of poisons, or by persons whose names are entered in a list kept by the appropriate local authority as sellers of Part II poisons. Sec. 17 (3) provides: 'In determining the distribution of poisons as between Part I and Part II of the said list, regard shall be had to the desirability of restricting the said Part II to articles which are in common use, or likely to come into common use, for purposes other than the treatment of human ailments, and which it is reasonably necessary to include in the said Part II if the public are to have adequate facilities for obtaining them.' The Secretary of State was empowered to make an order confirming, with or without modifications, the suggested list. The list can be, and has been, altered from time to time. Authorized sellers are registered pharmacists.

The present list is to be found in the Poisons List Confirmation Order, 1935 (S. R. and O., 1935, No. 1,238), as amended by the Orders of 1937 and 1938 (S. R. and O., 1937, No. 1,029, and S. R. and O., 1938, No. 1,547). The list is very extensive and it will be necessary to consult the orders themselves.

The Act empowered the Secretary of State to make rules for the distribution of the listed poisons, and this has been done by the Poisons Rules, 1935 (S. R. and O., 1935, No. 1,239), as amended by the Poisons (Amendment) Rules, 1937 (S. R. and O., 1937, No. 1,030). Very elaborate rules are provided therein.

Sec. 20 of the Act, however, *inter alia*, excepts from interference, except in so far as provided by any rules, the sale of poisons to registered veterinary surgeons for the purpose of their profession. Sec. 19, *inter alia*, permits the supply by a registered veterinary surgeon of a medicine containing listed poisons for the purposes of animal treatment, provided that (1) the medicine is distinctly labelled with the name and address of the person by whom it is supplied, and (2) on the day on which the medicine is supplied, or, if that is not reasonably practicable, on the next day, there are entered in a book, which is used regularly for the purpose of this provision, but which need not be used exclusively for that purpose, the following particulars: (a) the date on which the medicine was supplied, (b) the ingredients of the medicine and the quantity thereof supplied, and (c) the name of the person to whom it was supplied. No medicines containing poisons supplied by a veterinary surgeon are subject to the labelling provisions of Sec. 18. In the case of supply of poisons to a veterinary surgeon for the purposes of his profession the ordinary rule requiring a purchaser to sign the poisons book does not apply provided the order is in writing signed by the purchaser, and states his name, address and profession. Supply may be made to a veterinary surgeon without a written order provided the veterinary surgeon represents that he urgently requires the poison for the purpose of his profession, and the supplier is reasonably satisfied that the veterinary surgeon so requires the poison, and is, by reason of some emergency, unable before delivery either to furnish to the seller an order in writing duly signed, or to attend and sign the entry in the poisons book, and the veterinary surgeon undertakes to furnish a written order within twenty-four hours.

The rules apply particular restraints on the retail sale of:

Amidopyrine; its salts.

Barbituric acid; its salts; derivatives of barbituric acid; their salts; compounds of barbituric acid, its salts, its derivatives, their salts, with any other substance.

Dinitrocresols; dinitronaphthols; dinitrophenols; dinitrothymols.

Phenylcinchoninic acid; salicyl-cinchoninic acid; their salts; their esters.

Sulphonal; alkyl sulphonals.

Para-aminobenzenesulphonamide; its salts; derivatives of para-

aminobenzenesulphonamide having one or both of the hydrogen atoms of the para-amino group substituted by other radicals; their salts.

Such poisons may only be sold in accordance with a prescription given by a duly qualified medical practitioner, registered dentist or registered veterinary surgeon. In the case of a veterinary surgeon the prescription must (a) be in writing and be signed by the person giving it with his usual signature, and be dated by him; (b) specify the address of the person giving it; (c) specify the name and address of the person to whom the medicine is to be delivered; (d) have written thereon the words 'For animal treatment only'; and (e) indicate the total amount of the medicine to be supplied and the dose to be 'taken.' The prescription must not be dispensed more than once unless the prescriber has stated thereon that it may be dispensed more than once. If the prescription contains a direction that it may be dispensed a stated number of times or at stated intervals, it must not be dispensed otherwise than in accordance with that direction.

In general it is unlawful to sell or supply strychnine except as an ingredient in a medicine. There are limited exceptions to the rule, one of which is the supply to a registered veterinary surgeon for the purpose of being compounded in medicines prescribed or administered by him.

It is unlawful to sell or supply any poison (a) in the case of a liquid other than a medicine, contained in a bottle of a capacity of not more than 120 fluid ounces, unless the bottle is labelled with the words 'Not to be taken'; and (b) in the case of an embrocation, liniment, lotion, liquid antiseptic, or other liquid medicine for external application, unless the container is labelled with the name of the article and the words 'For external use only.'

No poison may be sold, supplied, or stored except in a container impervious to the poison and sufficiently stout to prevent leakage arising from the ordinary risks of handling and transport. With certain exceptions, which will not affect the ordinary veterinary practitioner, it is unlawful to supply a liquid poison, not being a medicine made up ready to be taken for the internal treatment of human ailments or a local anæsthetic for injection in the treatment of human or animal ailments, in a glass bottle of not more than 120 fluid ounces, unless the outer surface of the bottle is fluted vertically with ribs or grooves recognizable by touch.

INDEX

A

ABBREVIATIONS used in prescriptions, 89
 A.B.C. liniment, 224
 Abdomen, physical examination of, 18, 25
 Abdominal breathing, 13
 sounds, 18
 Abomasitis, 395
 Abortion, contagious bovine, 373
 Acacia, 340
 A.C.E. mixture, 188
 Accumulation, 57
 Aceta, 106
 Acetanilidum, 208
 Acetic acid, 175
 Acetonæmia, post-parturient, in cows, 398
 Acetone, tests for, 38
 Acetum, 175
 Acetylcholine, 260
 Acids, general action of, 169
 Acidum aceticum, 175
 acetylsalicylicum, 332
 ascorbicum, 359
 boricum, 173
 chromicum, 172
 citricum, 176
 gallicum, 320
 hydrochloricum, 171
 hydrocyanicum, 222
 nitricum, 170
 nitro-hydrochloricum dilutum, 172
 oleicum, 338
 picricum, 175
 salicylicum, 331
 sulphuricum, 169
 tannicum, 320
 tartaricum, 176
 Aconite, 224
 Acriflavine, 211
 Actions of drugs, 54
 circumstances modifying, 54
 Adeps, 344
 lanæ, 343
 Adjuvant, 86
 Adjuvants, digestive, 63

Administration and application of therapeutic agents, 96
 Adrenaline, 352
 Adventitious sounds, 19
 Æther, 195
 Agar, 340
 Agropyrum, 327
 Airoform, 153
 Airol, 153
 Albumin, tests for, 35
 Albuminuria, 32
 spurious, 33
 Alcohol, 182
 Alcohol tribromoethylicum, 245
 Alkalies and alkaline earths, 109
 Alkaloids, 108
 Aloe, 302
 Aloinum, 303
 Alteratives, 79
 formulæ for, 480
 Alum, 129
 Alumen, 129
 Aluminium silicate, 130
 American wormseed, oil of, 316
 Ammonium, salts of, 119
 Amylis nitris, 203
 Amylocainæ hydrochloridum, 244
 Amylum, 342
 Anæsthesia, epidural, 78, 477
 Anæsthetics, general, 77
 general, action of, 187
 local, 77, 241
 formulæ for, 504
 spinal, 78
 Analgesics, 76
 Anamnesis, 5
 Anaphrodisiacs, 70
 Anhidrotics, 81
 Aniseed, 285
 Anise, oil of, 285
 Anodynes, 76
 formulæ for, 483
 Anorexia, 21
 Antacids, 63
 Anthelmintics, 66, 314
 formulæ for, 490
 Anthracene purgatives, 302
 Anthraquinone, 302

Anthrax, 365
 Anti-emetics, 62
 Antifebrin, 208
 Antigalactagogues, 70
 Antimony, 153
 Antipruritics, 83
 Antipyretics, 79
 formulae for, 488
 Antipyrine, 207
 Antiseptics, 84
 gastric, 64
 intestinal, 65
 urinary, 69
 Antisialics, 61
 Antispasmodics, 77
 formulae for, 487
 Antizymotics, intestinal, 66
 formulae for, 487
 Anuria, 32
 Aphrodine, 334
 Aphrodisiacs, 69
 Apomorphinæ hydrochloridum, 236
 Appetite, depraved, 22
 excessive, 22
 loss of, 21
 Applications, cold and hot, 82
 Aqua, 177
 rosæ, 291
 Aquæ, 106
 Areca, 317
 Arecoline, 317
 Argentum, 136
 Argyrol, 137
 Arsenic, preparations of, 154
 Arsenium, 154
 Artificial respiration, 473
 Asafœtida, 298
 Ascariasis in the dog, 415
 Ascites, 418
 Ascorbic acid, 359
 Aspirin, 332
 Asthma, bronchial, in the horse,
 433
 spasmodic, in the dog, 442
 Astringents, 83
 formulae for, 494
 gastric, 62
 intestinal, 65
 Atoxyl, 155
 Atropina, 246
 Attitudes and postures assumed by
 patient, 27
 Aurantii cortex recens, 279
 Auscultation, abdomen, 26
 chest, 17
 heart, 11
 Autonomic nervous system, drugs
 acting on, 59
 Avertin, 245
 Azoturia, 458

B

Bacteria and their products, agents
 acting on, 84
 Balsams, 299
 Balsamum peruvianum, 299
 tolutanum, 299
 Barbiturates, 201
 Barium, salts of, 128
 Barley, 341
 Basilicon ointment, 296
 Basis, 86
 Baths, 96
 Beeswax, 345
 Belladonna, 246
 Benzaminæ lactas, 244
 Benzenum, 207
 Benzoated lard, 297, 344
 suet, 297, 344
 Benzoic acid, 297
 Benzoinum, 296
 Benzol, 207
 Betanaphthol, 210
 β-Eucaine, 244
 Bile, pigments in the urine, 34
 pigments, tests for, 37
 purified ox, 348
 B.I.P.P., 218
 Bismuth and Iodoform Paste, 218
 Bismuthum, 151
 Bitters, 278
 Black quarter, 366
 Black wash, 145
 Bladder, drugs acting on, 68
 inflammation of, in the horse, 425
 in the dog, 425
 Blaud's pill, 139
 Bleaching powder, 124
 Blister, application of, 351
 Blood vessels, drugs acting on, 73
 Blue ointment, 145
 pill, 144
 stone, 142
 Body surface, drugs acting on, 81
 Boluses, 96, 104
 Borax, 173
 Boric acid, 173
 Brandy, 183
 Braxy, 367
 Breathing, abdominal, 13
 irregular, 14
 thoracic, 14
 Brilliant green, 211
British Pharmacopœia, 106
 'Broken wind,' 435
 Bromine, 164
 Bromum, 164
 Bronchial muscular tissue, agents
 acting on, 75
 Bronchitis in the dog, 440
 in the horse, 428

- Broom tops, 255
 Brucine, 261, 266
 Buccal mucosa, alterations in the character of, 23
 Buchu, 295
 Bulimia, 22
 Burgundy pitch, 302
 Butea, 319
- C
- Cacao butter, 343
 Cade, oil of, 291
 Cæcum, impaction of, in the horse, 407
 Caffeine, 266
 Calabar bean, 256
 Calamine, 134
 Calciferol, 348
 Calcii hypophosphis, 160
 sulphurati, lotio, 166
 Calcium, salts of, 123
 therapy, 464
 Calculi, intestinal, in the horse, 409
 Calomel, 146
 Calumba, 278
 Calx, 123
 Cambogia, 309
 Camphora, 282
 Canine distemper, 371, 452
 hysteria, 450
 jaundice, 373
 typhus, 415
 Cannabis indica, 239
 Cantharides, 349
 Capsicum, 293
 Caraway, 286
 Carbolic acid, 212
 Carbon, 180
 dioxide, 182
 disulphide, 180
 tetrachloride, 181
 Cardamomum, 291
 Cardiac arrhythmia, 445
 depressants, 73
 sedatives, 73
 stimulants, 72
 tonics, 72
 Carminatives, 62
 Carron oil, 123
 Caryophyllum, oil of, 280
 Cascara sagrada, 306
 Cascarilla, 280
 Castile soap, 336
 Castor oil, 311
 Casts, in urine, 38
 Cataplasma kaolini, 130
 Cataplasmata, 83, 97
 Catarrh, acute intestinal, in the dog, 414
 acute nasal, in the dog, 439
- Catarrh in the horse, 427
 intestinal, in calves, 398, 414
 in cattle, 413
 in foals, 411
 Catechu, 321
 Cathartics, 64
 formulae for, 491
 Catheterization, 474
 Cattle, the nursing and care of sick, 48
 Caustic, lunar, 136
 potash, 109
 soda, 115
 toughened, 136
 Caustics, 83
 Cera, 109
 alba, 345
 flava, 345
 Cerebral sedatives, 76
 stimulants, 76
 Cetaceum, 345
 Chalk, prepared, 124
 Charcoal, 180
 Chenopodium, oil of, 316
 Cherry-laurel, 327
 Chest, physical examination of, 16
 Chinosol, 212
 Chiretta, 280
 Chloral hydrate, 197
 Chloramine, 161
 Chlorbutol, 199
 Chloretone, 199
 Chloric ether, 188
 Chlorinated lime, 124
 Chlorine, 161
 Chlorodyne, 231
 Chloroform, 187
 Chlorum, 161
 Cholagogues, 66
 Choline, 260
 Chromic acid, 172
 Chromii trioxidum, 172
 Chrysarobinum, 324
 Chrysophanic acid, 302
 Cinchona, 328
 Cinnamomum, 322
 Circulation, drugs acting on, 71
 Circulatory organs, disease of, in horses and cattle, 443
 Citric acid, 176
 Citrine ointment, 150
 Clothing for sick animals, 44
 Cloves, oil of, 280
 Clysters, 98
 Coal tar, 301
 Cobaltum, 143
 Cocaina, 241
 Cocoa butter, 343
 Codeina, 237
 Cod-liver oil, 347

Cold, application of, 82
 Colic, 403
 obstructive, in foals, 408
 simple or spasmodic, in the horse, 403
 Collodium, 197
 Colloidal preparations, 168
 Collutoria, 97
 formulæ for, 503
 Collyria, 97
 formulæ for, 503
 Colocynthis, 308
 Colophonium, 296
 Coniine, 255
 Conium, 255
 Constipation as a symptom, 28
 in the dog, 416
 in the horse, 412
 Contagious bovine abortion, 373
 Convallaria, 274
 Copaiba, 294
 Copper, salts of, 142
 Coriander, 286
 Corrective, 86
 Corrosive sublimate, 147
 Coryza in the dog, 439
 in the horse, 427
 Cotton wool, 335
 Couch grass, 327
 Cough as a symptom, 14
 Counter-irritants, 81
 formulæ for, 498
 Cows, the care of parturient, 49
 Cream of tartar, 114
 Creolin, 217
 Creosotum, 216
 Cresol, 217
 Creta præparata, 124
 Croton, oil of, 310
 Cubebæ fructus, 294
 Cumulative action of drugs, 57
 Cuprum, 142
 Curd soap, 336
 Cusso, 319
 Cyllin, 217
 Cystitis, acute, in the dog, 425
 chronic, in the dog, 426
 in the horse, 425

D

Dagenan, 361
 Dakin's solution, 161
 Dangerous drugs, law relating to, 508
 Decocta, 106
 Demulcents, 61, 335
 Deodorants, 85
 Depraved appetite, 22, 397
 Depressants, cardiac, 73
 spinal, 78

Dermatol, 153
 Derris, 228
 Dextrose, 338
 Diacetylmorphine hydrochloride, 238
 Diagnosis and general symptoms of disease, 4
 Diamorphine hydrochloride, 238
 Diaphoretics, 79, 80
 Diarrhoea as a symptom, 28
 in the horse, 410
 Diet for sick dogs, 52
 for sick horses, 45
 Digalen, 269
 Digestive adjuvants, 63
 disorders, symptoms associated with, 21
 system, diseases of, 384
 Digipoten, 269
 Digitalis, 268
 Dill, 286
 Discs, 108
 Disinfectants, 84
 Dissolution, law of, 184
 Distemper, 371, 452
 Diuretics, 67
 formulæ for, 488
 Diuretin, 268
 Dog, nursing and care of the sick, 50
 Dogs, weights of, 89
 Domestic utensils, measuring by, 92
 Donovan's solution, 150
 Dose, the, 88
 Dover's powder, 230, 325
 Draughts, 97
 Dropsical swellings as a symptom, 42
 Dropsy, 418
 Drugs, actions and uses of, 54
 administration of, 96
 circumstances modifying action of, 54
 classification of, 61
 dangerous, law relating to, 508
 modes of administration of, 54
 Dysentery in cattle, 414
 in lamb, 367
 Dyspepsia, acute gastric, in the dog, 399
 in calves, 398
 in cattle, 397
 in horses, 390
 post-parturient, 398
 Dyspnoea, 13
 Dysuria, 40

E

Easton's syrup, 140, 262
 Ecboics, 70
 Eclampsia, parturient, 466

Elæoptene, 280
 Electuaries, 98
 Electuarium, 104
 Embelia, 319
 Emetics, 63
 anti-, 62
 Emetine, 325
 Emodin, 302
 Emollients, 83, 335
 Emphysema, pulmonary, 435
 Emplastra, 98
 Empyema, 437, 438
 Emulsions, 105
 Endocrine products, 352
 Enemata, 98
 Enteritis, acute catarrhal, in the
 dog, 414
 in cattle, 413
 in the foal, 411
 in the horse, 409
 Enteritis, infectious feline, 372
 Ephedrinæ hydrochloridum, 353
 Epidural anæsthesia, 78, 477
 Epilepsy, 450
 Epinephrine, 352
 Epispastics, 81
 Epispasticus, liquor, 349
 Epsom salt, 126
 Ergometrine, 275
 Ergosterol, 348
 Ergota, 274
 Ergotamine, 275
 Ergotoxine, 275
 Eructation as a symptom, 29
 Escharotics, 83
 Eserine, 256
 Ether, 195
 spirit of nitrous, 204
 Ethocaine, 244
 β -Eucaïne, 244
 Eucalyptus, oil of, 284
 Euonymi cortex, 311
 Eupad, 161
 Eusol, 161
 Examination, clinical, 6
 Excipient, 87
 Exercise in sick animals, 48
 Expectorants, 74
 anti-, 74
 formulæ for, 482
 Extracta, 107
 Eye, drugs acting on, 79

F

Farina tritici, 342
 Fats, 108
 Febricula, 7
 Febrifuges, 79
 Feline enteritis, 372

Fell bovinum, 348
 Fennel, 286
 Fenugreek, 286
 Ferrum, 137
 Fibrolysine, 335
 Filix mas, 314
 Fixed oils, 108
 Flour, 342
 Fluoresceinum solubile, 212
 Foals, intestinal catarrh in, 411
 constipation in, 412
 Fœtor oris, 23
 Fomenta, 99
 Foods, invalid, for dogs, 52
 Foreign bodies in the rumen and
 reticulum, 394
 in the stomach of the dog,
 402
 Formaldehyde, 205
 Formalin, 205
 Formamine, 206
 Formamol, 207
 Formulæ for:
 alteratives, 480
 anæsthetics, local, 504
 anodynes, 483
 anthelmintics, 490
 antipyretics, 486
 antispasmodics, 487
 antizymotics, 487
 astringents, 494
 cathartics, 491
 collutoria, 503
 collyria, 503
 counter-irritants, 498
 diuretics, 486
 expectorants, 482
 gastric sedatives, 484
 hæmatinics, 496
 injection, intratracheal, for
 parasitic bronchitis in calves,
 504
 liniments, 498
 lotions, 502
 ointments, 504
 parasiticides, 500
 saline solution, hypertonic, 504
 sedatives, 483
 gastric, 484
 soaps, 501
 stomachics, 485
 tonics, 496
 Fowler's solution, 155
 Fremitus or thrill, 11
 Friar's balsam, 297

G

Galactagogues, 70
 Galla, 319

Gallic acid, 320
 Galls, 319
 Galyi, 155
 Gamboge, 309
 Gastric distension, acute, in the horse, 387
 impaction, in the horse, 388
 tympany, acute, in the horse, 389
 Gastritis in the dog, 400
 in the horse, 390
 parasitic, in cattle, 396
 Gastro-enteritis, hæmorrhagic, in the dog, 415
 Gaultheria, oil of, 333
 Gelatinum, 346
 Gelsemium, 256
 Generative organs, drugs acting on, 69
 Genitive case, rules for the formation of, 88
 Gentiana, 279
 Germicides, 84
 Ginger, 286
 Glauber's salts, 117
 Glonoin oil, 204
 Glucosides, 108
 Glucosum liquidum, 338
 Glycerina, 107
 Glycerinum, 337
 Glycerophosphates, 177
 Glycosuria, 35
 Glycyrrhiza, 340
 Gossypium, 335
 Goulard's extract, 133
 lotion, 133
 Gregory's powder, 306
 Grey powder, 145
 Grooming of sick animals, 48
 Gum acacia, 340
 resins, 109
 saline, 116
 Gummi, 109
 Gypsum, 124

H

Hæmatinics, 79
 formulae for, 496
 Hæmatoxyli lignum, 323
 Hæmaturia, 33
 Hæmoglobin, tests for, 36
 Hæmoglobinuria, 34
 equine, 458
 Hæmostatics, 83
 Halibut-liver oil, 347
 Hamamelis, 324
 Haustus, 104
 Heart, diseases of, 445
 drugs acting on, 71
 physical examination of, 11

Heat, application of, 83
 Helmitol, 207
 Hemlock, 255
 Henbane, 251
 Hepatis extractum liquidum, 357
 siccum, 357
 Heroin, 238
 Hexamine, 206
 Hexobarbitonum solubile, 202
 'Hide-bound,' 397
 Histamine, 275
 History of case, 5
 Homatropinæ hydrobromidum, 250
 Honey, 345
 Honeys, 107
 Hordeum decorticatedum, 341
 Horses, the nursing and care of sick, 43
 Hydrargyrum, 143
 Hydrocyanic acid, 222
 Hydrogen peroxide, 179
 Hydrothorax, 438
 Hydrous ointment, 220
 Hyoscine hydrobromidum, 251
 Hyoscyaminæ sulphas, 251
 Hyoscyamus, 251
 Hypertonic saline, formula for, 504
 Hypnotics, 76
 Hypocalcæmias, the, 462
 Hypomagnesiæmia of the cow, 462
 Hysteria, canine, 450

I

Ice, 178
 Ichthammol, 346
 Ichthyol, 346
 Icterus, 417
 Idiosyncrasy, 58
 Impaction, faecal, in the dog, 416
 in the foal, 408
 intestinal, in the horse, 405
 of cæcum in the horse, 407
 Incompatibility, 93
 Indian hemp, 239
 Influenza, equine, 451
 Infusa, 106
 Inhalations, 102
 Injections, epidural, 101
 hypodermic, 100, 104
 intramammary, 100, 478
 intramuscular, 100
 intraperitoneal, 100
 intraspinal, 101
 intratracheal, 101, 473
 intra-uterine, 101
 intravenous, 101
 rectal, 99
 subcutaneous, 100
 Inorganic acids, 169
 Inscription, 86

Insulinum, 356
 Intestinal antiseptics, 65
 antizymotics, 66
 astringents, 65
 calculi, 409
 Intestinal catarrh in calves, 414
 in cattle, 413
 in the foal, 411
 subacute, in the dog, 415
 impaction in the horse, 405
 sedatives, 65
 stimulants, 65
 tonics, 79
 tympy in the horse, 404
 Intestines, drugs acting on, 64
 Intramammary injection of anti-septic fluids, 478
 insufflation, 465
 Intratracheal injection, 101, 473
 Iodine, 162
 Iodoformum, 218
 Iodum, 162
 Ipecacuanha, 325
 Iron, salts of, 138

J

Jaborandi, 259
 Jalapa, 307
 Jasmine, 256
 Jaundice, 417
 infective canine, 373
 Johnin, 383
 Juniper, oil of, 290
 tar oil, 291

K

Kamala, 318
 Kaolinum, 130
 Keratin, 346
 Keratolytics, 83
 Kidneys, diseases of, in the horse,
 420
 in cattle, 423
 in the dog, 423
 drugs acting on, 67

Kino, 322

Krameria, 322

L

Lactation tetany, 467
 Lactoflavine, 359
 Lactosum, 338
 Lamb dysentery, 367
 Lambing sickness, 466
 Lamellæ, 97, 108
 Lampas, 385
 Lanolin, 343
 Lard, 344
 Laryngitis in the dog, 439
 in the horse, 428
 Laudanum, 230

Laurocerasi folia, 327
 Lavender, oil of, 290
 Law relating to dangerous drugs,
 508
 relating to poisons, 514
 Lead, salts of, 130
 Lily of the valley, 274
 Lime, 123
 Linctus, 104
 Linimenta, 108
 Liniments, formulæ for, 498
 Linimentum calcis, 123
 potassii iodidi cum sapone, 163
 Linseed, 312, 341
 oil of, 313
 Linum, 312, 341
 Liquor calcis saccharatus, 123, 336
 carbonis detergens, 301
 cresolis saponatus, 217
 epispasticus, 349
 ergosterolis irradiati. *See* Cal-
 ciferol, 348
 glycerylis trinitratis, 204
 hydrogenii peroxidi, 179
 picis carbonis, 301
 potassii hydroxidi, 110
 sodæ chlorinatæ chirurgicæ, 161
 Liqueores, 107
 Liquorice, 340
 Litharge, 132
 Lithontriptics, 69
 Liver, diseases of, 416
 drugs acting on, 66
 extracts of, 357
 Lobelia, 255
 Logwood, 323
 Lotiones, 108
 Lotions, formulæ for, 502
 Lugol's solution, 162
 Lunar caustic, 136
 Lymphangitis, 456
 Lymph lavage, 177
 Lysol, 217

M

Magnesium, salts of, 126
 Male fern, 314
 Mallein tests, 381
 Malt, 342
 Mammary glands, drugs acting on,
 70
 Materia medica, groups, 109
 "M. & B. 693," 361
 Measures, domestic, 92
 stock, 92
 weights and their symbols, 90
 Medicines, administration of, 96
 circumstances modifying action
 of, 54

Mel depuratum, 345
 Mellita, 107
 Meningo-encephalitis, 448
 -myelitis, 448
 Menthol, 281
 Mercury, preparations and salts of,
 144
 Metalloids, 153
 Metals, 129
 Methylated spirit, 183
 Methylin salicylas, 334
 Metric system of weights and
 measures, 91
 Milk fever, 462
 Mindererus' spirit, 122
 Mistura alba, 126
 cretæ, 124
 Misturæ, 104, 107
 Mixtures, 104
 Morphine, 230
 Mouth and salivary glands, drugs
 acting on, 61
 Mucilages, 109
 Mucous membranes, alterations in,
 as symptoms, 20
 Murmurs, cardiac, 12
 Muscarine, 260
 Mustard, 292
 Mydriatics, 79
 Myoglobinuria, equine, 458
 Myotics, 79
 Myrrha, 298

N

Naphthalene, 210
 Naphthol, 210
 Narcotics, 75
 Nasal catarrh in the horse, 427
 discharge as a symptom, 14
 Nembutal, 202
 Neoarsphenamina, 155
 Nephritis in cattle, 423
 in the dog, 423
 in the horse, 420
 Nerve endings, drugs acting on, 78
 Nerve tonics, 79
 Nervous system, diseases of the, 448
 drugs acting on the, 16
 symptoms associated with
 the, 40
 Neutral organic principles, 108
 Nicotina, 253
 Nicotinic acid, 359
 Nikethamide, 203
 Nitre, 111
 sweet spirit of, 204
 Nitroglycerin, 204
 Normal saline solution, 116
 Novocain, 244
 Nutrient enemata, 99

Nutrient suppositories, 102
 Nux arecæ, 317
 vomica, 261

O

Oculenta, 108
 Oedema of the limbs as a symptom,
 42
 Oesophagismus, 387
 Oesophagitis, 386
 Ointments, 105
 formulæ for, 504
 Oleic acid, 338
 Oleo-resins, 109, 298
 Oleum anisi, 285
 cadinum, 291
 caryophylli, 280
 cetacei, 345
 chenopodii, 316
 crotonis, 310
 eucalypti, 284
 gaultheriæ, 333
 hippoglossi, 347
 juniperi, 290
 lavandulæ, 290
 lini, 313
 menthæ piperitæ, 281
 viridis, 290
 morrhue, 347
 olivæ, 335
 origani, 290
 pice liquidæ, 300
 rectificatum, 300
 ricini, 311
 rosmarini, 290
 santali, 295
 sinapis volatile, 292
 terebinthinæ, 286
 theobromatis, 343

Oliguria, 31
 Olive oil, 335
 Omasum, impaction of, 395
 Omnopon, 238
 Opium, 229
 Orange peel, 279
 Organic acids, 175
 Origanum, oil of, 290
 Orthocaina, 212
 Orthoform, 212
 Ox bile, 348
 Oxygen, 179
 Oxymel, 175
 Oxytocics, 70

P

Pachymeningitis, chronic ossifying
 spinal, 449
 Pain, abdominal, 23
 Pantopon, 238
 Papaveretum, 238

Paracentesis, 471
 Paraffina, 219
 Paraffin oil, 220
 Paraldehydum, 200
 Parasitic bronchitis in calves, formula for, 504
 Parasitocides, 83
 formulae for, 500
 Parasympathetic nervous system, drugs acting on, 60
 Parathormone, 356
 Parathyroideum, 356
 Paregoric, 230, 282
 Pareira, 296
 Paris, plaster of, 124
 Paroidin, 356
 Parrish's food, 139
 Parturient eclampsia, 466
 hypocalcæmia of cows, 462
 Pelletierinæ tannas, 318
 Pentothal sodium, 202
 Pepper, 293
 Peppermint, oil of, 281
 Pepsinum, 348
 Percentage solutions, table of, 93
 Percentages, Leonard's method of reducing, 93
 Percussion, chest, 16
 heart, 11
 Pericarditis, acute, in horses and cattle, 443
 in the dog, 444
 Peritonitis, 418
 Peru, balsam of, 299
 Pessaries, 101
 Pessus, 101
 Pharmacy, 103
 Pharyngitis, 385
 Phenacetinum, 209
 Phenazonum, 207
 Phenobarbitone, 201
 Phenol, 212
 Phenolphthaleinum, 221
 Phenothiazine, 221
 Phenyl salicylate, 209
 Phlebotomy, 478
 Phosphorus, 159
 Physostigmine, 256
 Pica, 22, 397
 Picric acid, 175
 Pilocarpine, 259
 Pilulæ, 104, 107
 Pine, 137, 143
 Piper nigrum, 293
 Piroplasmosis, bovine, 460
 Pitch, 301
 Pituitrin, 354
 Pix burgundica, 302
 carbonis præparata, 301
 liquida, 300

Pix nigra, 301
 Plaster of paris, 124
 Plasters, 98
 Pleurisy in cattle, 439
 in the dog, 442
 in the horse, 436
 Plumbum, 130
 Pneumonia, in cattle, 439
 in the dog, 440
 in the horse, 429
 Podophylli resina, 309
 Poisons, law relating to, 514
 Polyuria, 32
 Post-parturient dyspepsia in cows, 398
 Potassium bichromate, 172
 iodide, 162
 salts of, 109
 Poultices, 83, 97
 Powders, 101, 103
 Prescription writing, 86
 abbreviations used in, 89
 Probang, the, 469
 Procainæ hydrochloridum, 244
 Prognosis, 5
 Prontosil, 360
 Protargol, 137
 Prussic acid, 222
 Pulmonary congestion, in the horse, 434
 emphysema, 435
 Pulp kidney disease, 368
 Pulse, alterations in character of, 8
 Pulveres, 103, 107
 Purgatives, 64
 anthracene, 302
 cholagogue, 66
 drastic, 307
 formulae for, 491
 general effects of, 65
 hydragogue, 65
 oleaginous, 311
 saline, 64
 simple, 65
 vegetable, 302
 Purpura, equine, 454
 Pustulants, 81
 Pyuria, 35

Q

Quassia, 278
 Quininæ et uræ hydrochloridum, 245
 Quinine, 328

R

Râles, 19
 Rectal exploration, evidence furnished by, 26
 Rectified spirit, 183
 of tar, 300

Red precipitate, 145
 Red water, 460
 Regurgitation as a symptom, 29
 Renal diseases, general symptoms
 of, 39
 Resin, 296
 Resins, 109, 296
 Resorcin, 209
 Resorcinol, 209
 Respiration, artificial, 473
 types of, 13
 Respiratory functions, symptoms
 associated with, 13
 Respiratory organs, catarrhal affec-
 tions of, 427
 drugs acting on, 74
 Respiratory sedatives, 75
 sounds, abnormal, 18
 adventitious, 19
 stimulants, 75

Rhatany root, 322
 Rheum, 305
 Rhinitis in the horse, 427
 Rhonchi, varieties of, 19
 Rhubarb, 305
 Rigor as a symptom, 42
 Rosemary, oil of, 290
 Rose water, 291
 Rotenone, 229
 Rothera's test, 38
 Rubefacients, 81
 Rumens, impaction of the, 391
 tympanites of the, 393

S

Sal alembroth, 149
 ammoniac, 122
 volatile, 120
 Salicinum, 331
 Salicylic acid, 331
 Saline diuretics, 67
 normal, 116
 purgatives, 64
 solution, hypertonic, formulæ
 for, 504
 Salivation as a symptom, 22
 Salol, 209
 Saltpetre, 111
 Salvarsan, 155
 Sandal wood, oil of, 295
 Santoninum, 315
 Sapo, 336
 Scammonia resina, 308
 Scarlet red, 211
 Scilla, 273
 Scoparium, 255
 Scopolamine, 251
 Sedatives, cardiac, 73
 cerebral, 76
 formulæ for, 483

Sedatives, gastric, 62
 formulæ for, 484
 intestinal, 65
 respiratory, 75
 vesical, 68
 Senna, 307
 Serpentry, 280
 Sevum, 344
 Sherry, 183
 Sialagogues, 61
 Signature, 86
 Silver, salts of, 136
 Simple ointment, 220
 Sinapsis, 292
 Skin, agents acting on, 80
 Slaked lime, 123
 Small colon, impaction of, in the
 horse, 407
 Snoring, 14
 Soaps, 336
 formulæ for, 501
 Sodium aminarsonas, 155
 biborate, 173
 cacodylate, 155
 citrate, 177
 hypophosphite, 160
 iodide, 163
 nitrate, 204
 salts of, 114
 Soft soap, 336
 Soluseptasine, 360
 Solutions, percentage, table of, 93
 Soporifics, 76
 Spanish fly, 349
 Sparteine, 256
 Spearmint, oil of, 290
 Spermaceti, 345
 Sperm oil, 345
 Spinal anæsthesia, 78
 depressants, 78
 stimulants, 78
 Spiritus, 107
 ætheris nitrosi, 204
 ammonia aromaticus, 121
 frumenti, 183
 methylatis industrialis, 183
 vini gallici, 183
 Spirochaetosis ictero-hæmorrhagica,
 373
 Squill, 273
 Standard wire gauge, 507
 Staphisagria semina, 228
 Starch, 342
 Stavesacre, 228
 Stearoptene, 280
 Stimulants, cardiac, 72
 cerebral, 76
 gastric, 62
 nervo-muscular gastric, 62
 respiratory, 75

Stimulants, spinal, 78
 Stockholm tar, 300
 Stomach, drugs acting on, 61
 tube, the, 470
 Stomachics, 61
 formulæ for, 485
 Stomatitis, 384
 Storax, 300
 Stovaine, 244
 Stramonium, 252
 Strangles, 427
 Strangury, 40
 Streptococcal infections, 369
 Strophanthus, 272
 Strychnine, 261
 Stüttgart disease, 415
 Styptics, 83
 Styrax, 300
 Subscription, 86
 Sucrosum, 338
 Sudorifics, 80
 Suet, 344
 Sugar of lead, 132
 Sugar tests for, 37
 Sugars, 338
 Sulphanilamides and allied com-
 pounds, 360
 Sulphapyridine, 361
 Sulpharsenamina, 155
 Sulphathiazole, 362
 Sulphonol, 200
 Sulphur, 166
 Superpurgation in the horse, 410
 Superscription, 86
 Suppositories, 102
 Suppositories, 98
 glycerin, 98
 nutrient, 98
 Suppurants, 81
 Surface of the body, symptoms
 furnished by the, 41
 Suspensions, 105
 Swayback, 143
 Sweating, profuse, as a symptom,
 42
 Sweet spirit of nitre, 204
 Swelling, dropsical, as a symptom,
 42
 Swine erysipelas, 369
 fever, 370
 Sympathetic nervous system, drugs
 acting on, 59
 Sympathicotonia, 61
 Symptomatic treatment, 4
 Symptoms, 5
 Synergism, 58
 Syrup, Easton's, 140
 Parrish's, 139
 Syrupi, 107
 Syrupus, 338

T

Tabaci folia, 253
 Table for preparation of percentage
 solutions, 93
 of thermometric equivalents,
 507
 Tannalbin, 321
 Tannic acid, 320
 Tannigen, 321
 Tannin, 320
 Tannoform, 207, 321
 Taraxicum, 280
 Tar camphor, 210
 oil of, 300
 Tar, rectified spirit of, 300
 Tars, 300
 Tartar, cream of, 114
 emetic, 153
 Temperature, 6
 Terebenum, 289
 Terebinthinæ, oleum, 286
 Tetanus, 368, 457
 Tetany, lactation, 467
 transit, 467
 Thebaine, 238
 Theobroma, oil of, 343
 Theobromina et sodii salicylas, 268
 Theriaca, 339
 Thermometric equivalents, table of,
 507
 Thioform, 153
 Thiosinamine, 335
 Thirst, as a symptom, 22
 Thymol, 284
 Thyroideum, 355
 Thyroxinum, 355
 Time in relation to action of drugs,
 58
 Tinctura chloroformi et morphinæ
 composita, 188, 231
 Tincturæ, 107
 Tissue change, drugs acting on, 79
 Tobacco, 253
 Toleration and habit, 57
 Tolu, balsam of, 299
 Tonics, 79
 gastric or stomachic, 62
 Tragacanth, 339
 Transit tetany, 467
 Treacle, 339
 Tribromoethyl alcohol, 245
 Trinitroglycerin, 204
 Trinitrophenol, 175
 Triticum, 327
 Trypan blue, 210
 Tuba, 228
 Tuberculin tests, 375
 Turpentine, oil of, 286
 Tympanitis in cattle, 393
 gastric, in the horse, 389

Tympanites, intestinal, in the horse, 404
 Typhus, canine, 415
 Tyramine, 275

U

Unguenta, 105
 Unguentum aquosum, 220
 simplex, 220
 Urinary antiseptics, 68
 organs, diseases of, 420
 drugs acting on, 67
 symptoms associated with, 30
 Urine, abnormalities in, 31
 agents modifying the reaction of, 68
 characters of, 31
 examination of, 35
 incontinence of, 40
 retention of, 40
 Urotropine, 206
 Urticaria, 453
 Uterine irrigation in mare and cow, 476
 Uva ursi, 296

V

Vaccine and serum therapy, 363
 Vagotonia, 61
 Valeriana, 292
 Vapores, 102
 Vaso-constrictors, 73
 dilators, 74
 Vehicle, 87
 Venesection, 80, 478
 Veratrina, 227
 Vermicides, 66
 Vermifuges, 66
 Vesical sedatives, 68
 Vesicants, 81
 Vinegar, 175

Vinum xericum, 183
 Vitamins, 358 *et seq.*
 Vitriol, blue, 142
 Volatile, ethereal or essential
 108, 280
 Volvulus in the horse, 407
 Vomiting as a symptom, 20

W

Wash black, 145
 yellow, 146
 Water, 177
 Wax, 109, 345
 Weights and measures, 90
 metric system of, 91
 Wheaten flour, 342
 Whisky, 183
 White lead, 132
 lotion, 133
 precipitate, 149
 White scour, 369
 Wintergreen, oil of, 333
 Wire gauge, standard, 507
 Witch hazel, 324
 Wool, cotton, 335
 fat, 343
 Worm seed, oil of, 315

X

Xylenol, 215

Y

Yellow wash, 146
 Yellows, the, 373
 Yohimbine, 334

Z

Zinc, salts of, 134
 Zingiber, 286

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